# "MINING,"

## A JOURNAL DEVOTED TO THE INTERESTS OF MINERS & MINING STUDENTS.

## VOLUME II.—1893-94.

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1894.

# INDEX.

# MINING

## A Journal devoted to the interests of Mining.

No. 1. Vol. II. SATURDAY, DECEMBER 2, 1893. FORTNIGHTLY ONE PENNY


**CONTENTS.**



## INTRODUCTION TO VOL. II.

TO OUR READERS.

WE are now commencing the Second Volume of this Journal. It has now been before the public one year, in spite of the many predictions that we would never exceed a few issues. Many said that we could not possibly clear the expenses of production, giving, as we did, the great amount of solid matter in each issue. We do not advocate superfluous writing, cramming articles, or puffing paragraphs to fill up space, but have tried at all times, to the best of our ability, to give our readers as much information relating to mining as we possibly could print in our small paper. That our endeavours have been appreciated in the past our very existence is positive proof, as without a large circulation we could not meet the expenses which are incurred in producing the paper, and retaining the services of its numerous contributors. Like all new papers we had many obstacles to contend with. Our Journal has fought its way on its own merits, and having done so is still handicapped by the Newsagents, who seem to be prejudiced against new papers. We have had numerous complaints from would-be subscribers that their Newsagents would not trouble themselves to get "Mining" for them. Of course the sale must naturally be small at the commencement, but we flatter ourselves to think that if Newsagents would be kind enough to oblige their customers with "Mining" that the sale will prove satisfactory to all in a very short time. We are satisfied that our manner of conducting this Journal in the past has pleased our readers, as we are daily receiving letters of approbation from well-wishers. We have tried to increase the value of the paper to mining students each issue, and will endeavour to further anhance its value in the second volume. We hope that each well-wisher will recommend "Mining" to all his *mining friends*, and **by doing so *he will assist us considerably.***

## HAULAGE.

### CHAPTER II.

#### TRAMS.

TRAMS may be divided into two classes, namely:—Those that have the body made of wood and those that are made of iron. The various advantages possessed by each may be summed up as follows:—Wooden ones are cheaper for first cost, lighter, and can be easily repaired when damaged; but if the wood becomes saturated with water it soon rots away. On the other hand iron withstands the action of water much better than wood, and for wet seams are more preferable, but if a train of tubs leave the rails the iron is generally crushed out of shape, and in the majority of cases cannot be made right again. On the whole wooden tubs are far cheaper to repair and are more economical for rough work.

Figs. 1 and 2 show two descriptions of iron tubs, only the lower framework being made of wood. Figs. 3 and 4 show two common forms of wooden tubs. They consist of an oak frame secured to which is a drawbar of iron which passes from end to end, and to which the coupling links are attached. The sides may be vertical (Fig. 3) or inclined outward from the bottom (Fig. 4)—by which the advantage of using larger wheels is obtained—and consist of elm, or

preferably oak, about one inch thick, bolted to upright bands of iron (Fig. 3) which are fastened to the frame at the bottom—one at each corner and one in the middle of each side. A band of hoop-iron is also fastened round

Fig. 1

the top to strengthen it, and prevent the wood from wearing as quickly as it otherwise would do. In the place of straps of iron the sides may be strengthened by horizontal stays of timber (Fig. 4), but the iron straps are more durable, though the first cost of the tub will be a little more. The wheels range from eight to twelve inches in diameter, when placed below the body of the tub, to eighteen inches in diameter when they are at the sides. Large

Fig. 2.

wheels reduce the friction, but the height of the roads must be taken into account, so that in many cases the wheels must be small. If the width of the tub is decreased at the bottom to increase the size of the wheels, the capacity for the same height is less, and the tubs are more easily tippled over. The wheels may be fast to the axle, or may work loose upon it, the fast wheels however reducing the friction on straight roads, but not being suitable for very crooked or irregularly-laid roads, or where the trams are run at high speeds.

The distance between the couplings is also a consideration. They should be made as close together as possible for crooked roads so as to facilitate the turning of the tubs, but this, similar to the inclined sides, lessens the steadiness of the tubs.

Fig. 3.

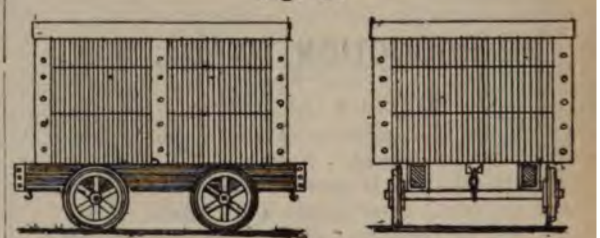


Fig. 4

The size of the tubs is decided after many things have been considered. The tubs must be necessarily small in thin seams, but in high seams they may be made larger. Here again the size is restricted by the weight a man can conveniently handle. The tub will often become displaced from the rails, and it is necessary that the weight be such that the putter can replace it himself. A good size, when the height of the road allows,

is one having a capacity of about ten cwt., and which will weigh from three to four cwt., but for thin seams the capacity becomes as low as five cwt. For calculations on haulage four-cwt. tubs may be taken with a capacity of ten cwt.

*(To be continued.)*

## SAFETY APPLIANCES.

### Detaching Hooks.

IN drawing attention to this class of apparatus it is almost superfluous to impress on those who have charge of our mines the advantage derived from their application. The numerous accidents constantly occurring from over-winding, and the resulting loss of life and destruction of property are arguments so irresistible as to require no support.

The principle of these inventions is the detaching of the cage when the

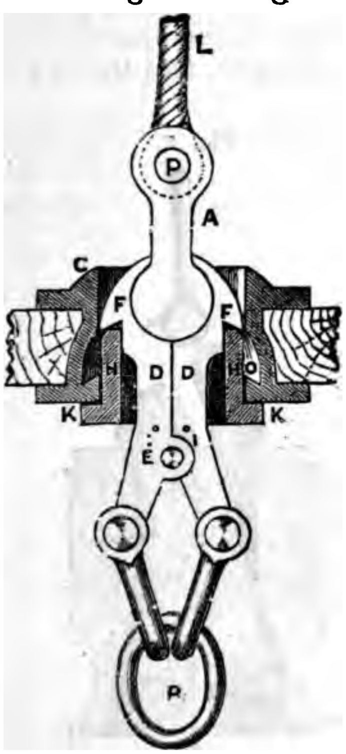



**FIG 1.—Illustrating hook just entering the supporting ring.**

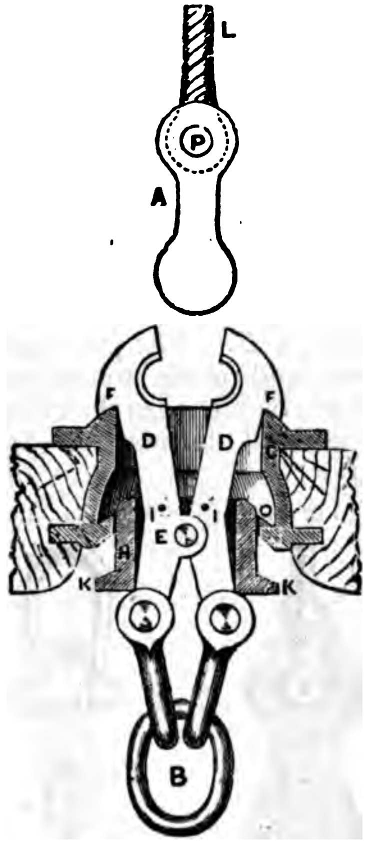



**FIG. 2.—Illustrating the position after detachment.**

rope is "pulleyed," that is drawn over the pulley—the result of the winding-engine not being stopped at the proper moment. The load being drawn above a certain point, the weight of the load compels the rope to become detached, which detaching cannot take place until the jaw hooks have a firm hold on the supporting ring.

Figures 1 and 2 represent the Walker Detaching Hook, invented over twenty years ago by Mr. Wm. Walker, Saltburn-by-the-Sea, and since that time it has given universal satisfaction.

The principle upon which it works is as follows:—The lifting rope is attached to the shackle A, and the load to the connecting link B. The supporting ring C (through which

the rope is constantly working), is a fixture in a baulk of timber or iron girder at the pit top. The hook consists of a pair of jaws, D D, working on a centre pin, E, in such a manner that the weight of the load has a tendency to open the lower limbs, which clip the strong centre pin of the shackle A. The upper limbs are formed externally with jaw hooks, F F. The jaws are kept together, and made to retain the shackle pin by means of the clamp H, which is held in position by the pins I I.

Fig 3.

Fig. 4.

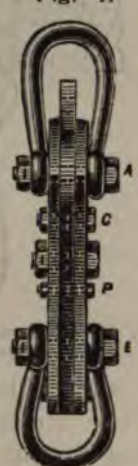



**Figure 3 is a side-view of the Link.**
**Figure 4 is a cross-view of the same.**

In case of over-winding, the jaw hooks (held together by the clamp), pass freely into the ring C, but the projections K K, of the clamp coming into contact with the bottom flange of the said ring hold the clamp stationary while the jaws are being pulled through, the result being that the pins I I are sheared off, and the jaw hooks released from the restraint of the clamp. The internal diameter of the ring being the same as the width across the jaw hooks, F F, the rope remains secure until the jaw hooks reach the top of the ring, when by the action of the weight of the load, they are forced open, and so hook on to the top of the supporting ring C, as shown in Fig. 4, the rope passing harmlessly over the pulley. The recess O in the ring C is intended to meet an imaginary case that experiment shows to be almost impossible, namely, that if the engine is reversed after the pins I I are cut, and before the hooks reach the top of the ring, the jaws will then hook into the recess, and the load remain suspended in perfect safety It will be observed that the upper edge of the ring C is curved to match the sweep of the jaw hooks when opening. By this arrangement all shock is avoided.

It may be worth while to mention a two-fold cause of safety to be found in this hook, namely, supposing what is a practical impossibility, that the load did not force open the jaws, the bottom flange of the ring would then press the clamp against the incline of the lower limbs, thereby causing the jaws to open, and the jaw hooks to act.

Fig. 5.


**Figure 5 represents the position after detachment.**

Fig. 6.

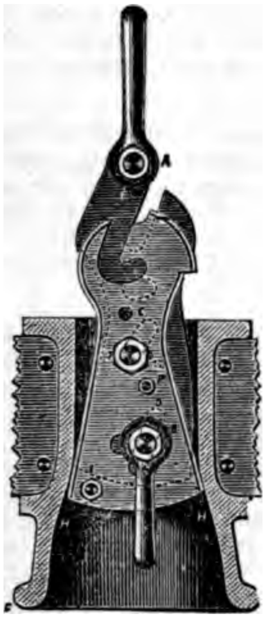


Figure 6 shows the rope shackle re-connected fcr lowering the link through the cylinder.

The remaining engravings illustrate the Ormerod Improved Safety Link, which has given good results, judging from the large number now in use. It will be seen on reference to the engravings that the apparatus when in ordinary use, as in Fig. 3, is wider at the bottom than the top; but in the event of overwinding, the link is drawn into the bell-mouthed cylinder FF in Fig. 5, the wide part of the link at H H coming in contact with the cylinder at F F, thereby closing the bottom part of the link, and causing the top part to expand and the projections to catch over the top of the cylinder, while at the same time the rope shackle A is forced out of its seat, and allowed to go free, and the bottom shackle B drops into the slot D and locks the link firmly in its position. The cage being suspended from the chain cannot fall back. To prevent the possibility of the link becoming disarranged in ordinary work, a small pin P is inserted through the plates, which pin is sheared off as the apparatus passes into the cylinder. By a recent invention a clasp stud E is inserted over the hook points of the outside plates which considerably strengthens the link in case of excessive strain or jerk.

For lowering the cage the shackle is attached to the ear on the middle plate as shown in Fig. 6. On removing the pin C, and slighty winding the rope, the middle plate (having a slotted hole in it) is elevated into the position shown, and allows the apparatus to pass down through the cylinder, and safely lowers the cage.

Fig. 7.

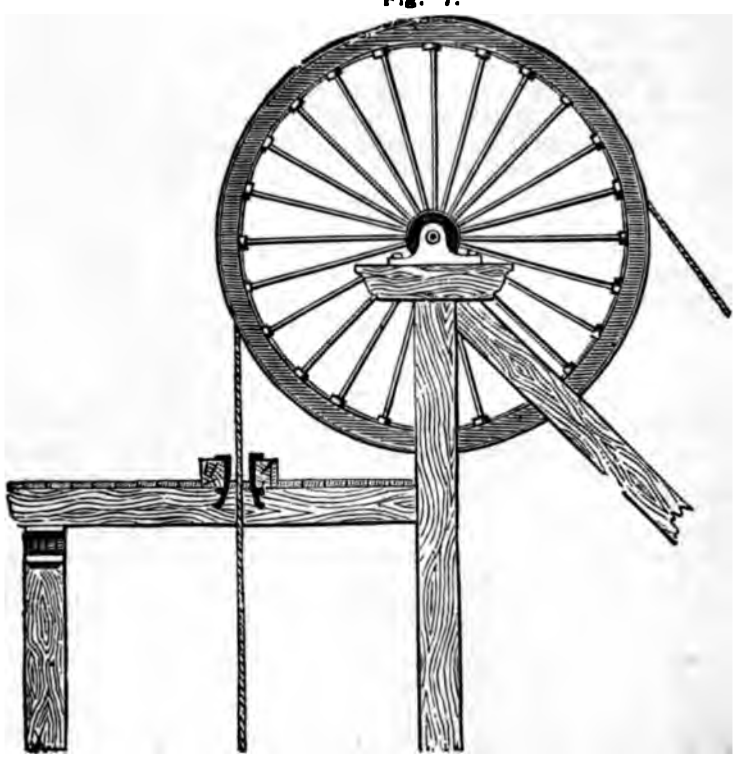


Figure 7 shows a section of the cylinder as fixed in the headgear or pit frame.

# EXAMINATION QUESTIONS,

With Answers, by

THOS. FLETCHER, First-Class Certificated Manager

The following questions for the examination of Candidates for Certificates of Competency were set in the Manchester District, 1890.

## FIRST-CLASS CERTIFICATES OF COMPETENCY.

*(Continued from last issue.)*

### Practical Working of Collieries.

QUESTION 7.—When the roof in a goaf first begins to "weigh" in a fiery mine, what dangers would you apprehend, and what precautions would you take?

ANSWER.—The dangers which I would apprehend are large quantities of gas, and large falls, which would sweep the gas out suddenly. I would therefore remove all the workmen and lights from that part of the mine, and from every place between that and the up-cast shaft, and would fence off all entrances to same, and not allow any workmen to enter until a competent person had pronounced them safe.

QUESTION 8.—What are the chief sources of danger to sinkers, and how would you guard against them?

ANSWER.—The dangers to which sinkers are exposed to are:—(1) Stones or metal falling from the sides which have not yet been walled. (2) Material falling down the pit. (3) Danger from shot-firing. There are many other causes by which sinkers loose their lives, but the foregoing are the principal ones. I would guard against them (1) by having the sides examined below the bricking every shift, and immediately after every succession of shots before the men are allowed to descend. (2) by having a banking wagon with a back about four feet high. This covers the pit top whilst the hoppit is being unhooked from the winding rope, and another hoppit is being attached. In this manner any material that may fall out of the hoppit during removal is prevented from falling down the shaft. When the bank wagon is pushed back to allow of the empty hoppit descending, the upright back forms a fence for one side of the shaft. The other sides should also be protected by fences. I would see that the hoppits are not overfilled and that nothing adheres to the sides or bottom, and that it is steadied before being sent off. (3) By having the shots fired by electricity from the surface, previous to which the men must be brought up the shaft, or to a mouthings in the shaft.

QUESTION 9.—A mine 4 feet thick is standing in pillars 50 yards long and 40 yards wide; dip of seam, 1 in 5; roof tender. How would you proceed to remove the pillars?

ANSWER.—I would remove the pillar, under these circumstances, in one operation—that is, commence on the lower side and advance to the rise, taking the coal in one breast like a wide work face. This method would be safest and most economical.

QUESTION 10.—In a mine worked by longwall the face is advancing towards old workings. How would you proceed?

ANSWER.—The manner in which I would proceed would depend upon what I thought existed in the old workings. If I expected water I would have two narrow places driven forty yards or more in advance, with a central borehole, and sufficient flank holes in each place, kept at least five yards ahead. I would also have plugs at hand to stop the influx of the water in case the boreholes happened to tap it. I would not allow any lights other than a good safety lamp.

QUESTION 11.—Describe the method of working and timbering a longwall face in a mine 3 feet thick, with a soft floor and a hard roof.

ANSWER.—I would work such a seam on the face, and have the places a few yards in advance of each other. This would prevent the floor from rising quite so much as otherwise. I would take some of the roof down in the roads for building stones, and to give the necessary height I would support the roof along the working face by two rows of chocks placed about two yards apart, and props where required. The props should of course be provided with good wide footpieces.

QUESTION 12.—Say what safety lamp, in your opinion, most nearly meets the requirements of the Mines Act, and explain the principles of its construction.

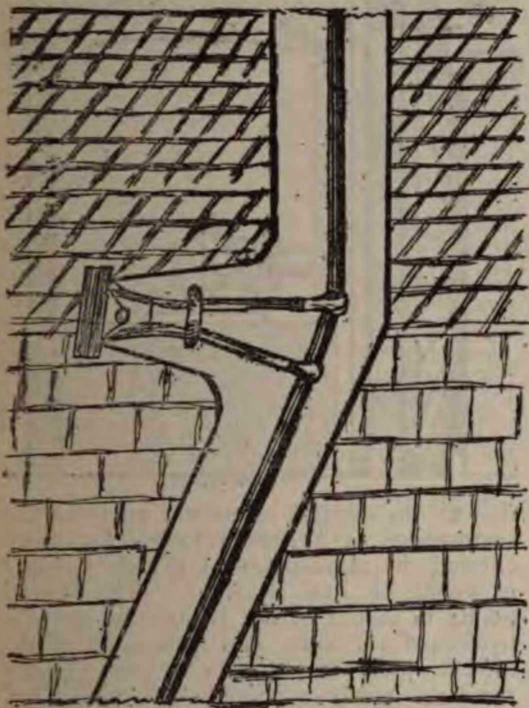
ANSWER.—The *Marsaut* Lamp, in my opinion, most nearly meets the requirements of the C.M.R.A. The upper part consists of a glass cylinder which surrounds the light, and over this two or three gauzes are fitted. The gauzes fit one over the other, but touch only at the base. This makes it much safer than the *Clanny* Lamp, and in addition, a shield or bonnet surrounds the gauze, and prevents strong currents of air from impinging direct on to it, and forcing the flame through. The air to feed the lamp passes over the top of the glass.

*(To be continued.)*

## ANSWERS TO QUESTIONS

**In No. 25.**

*Question* 1. (E.)—Explain, with sketch, angle bobs for pump spears changing from the vertical.



*Answer.*—Angle or V-bobs are used when the direction of the pump spears deviate from the vertical. This contrivance is mostly used for guiding the pump spears in the under-lie shafts of metal mining. As will be seen in sketch the angle bobs are always fixed on the side of the spears where the two lengths are jointed, and make an angle with each other of less than 180 degrees.

GEO. A. HAWES,
Holy Trinity Terrace,
Murton Colliery.

*Question* 2. (E.)—How do you account for the disjointing of our widely-distributed Coal Measures strata, and for the absence of it now?

*Answer.*—The coal measures strata being generally made up of shales which become plastic or soft when acted on by water, and sandstones being of a soft friable nature, when elevated by upheavals in the earth's crust, they were broken up by atmospheric and water agencies, and when once disintegrated they were carried off by surface floods with the result that the extent of the coal measures strata was reduced in all elevated regions, and by the same cause the great coalfield was cut up into several comparatively small patches, known as the coalfields of the British Isles. The study of these coalfields furnishes indisputable proof of their relationship to each other, and that they are the remains of a once greater coalfield. I account for its absence now by the decreasing temperature brought about by numerous shafts and workings, which also allow free exit for the gases, etc., which otherwise would tend to cause such upheavals.

MATTHEW MOURLEY,
Rock Terrace, Soothill Lane,
Batley, Yorkshire.

*Question* 3. (E.)—Explain, with sketch, the longwall method of working coal.

*Answer.*—Longwall may be divided into two kinds:—1. Longwall advancing, or working from home. 2. Longwall retreating, or working back from the boundaries towards the shafts.

Longwall advancing.—In this method the total extraction of the seam commences from the shaft pillar, which must be left intact to maintain the stability of the shafts; the coal is removed in a long length or face which may be in one straight line, or in a series of steps, which depends upon circumstances. It generally works better when advancing across the line of the cleat. Sometimes, in order to get round coal, the face is carried forward end on, or in the line of the cleat. The coal is undercut, holed, or kirved along the face by hewers or by machine coal-cutters. This is usually done in the bottom part of

the seam, or, if there be a bottom layer of soft stone or band, the under-cutting is done in it. The depth to which the coal is under-cut varies from three to six feet, and is in the form of a wedge. During the kirving the men are protected from falls of coal by short sprags set at distances of not more than six feet apart, along the face, under which the coal may be removed as the face is ready for wedging or blasting down. As the face advances roads must be formed, and kept open through the goaf to communicate with the shafts. This is done by building walls of stone, called "packs" or "pack-walls," on either side of the road from the floor to the roof. The stone for this purpose is obtained from the roof which is usually taken down in the roadways to make height for tubs to travel, or may be taken from the floor. When a number of gateways have advanced a considerable distance, it is difficult and expensive to maintain them. One main gateway is then maintained, and a cross-gateway is then formed across the other gateways. These cross-gates enable the old gateways to be dispensed with, so that the distance of haulage and cost of maintenance is reduced. Complete stowage of the goaf ensures success,

Longwall retreating.—This method consists in driving winning places, levels, haulage roads, and air-ways to the boundaries, and when the latter are reached, to extract the coal by the longwall face and work back in the direction of the shafts. Speaking generally longwall advancing is more frequently adopted and is more applicable to thin than thick seams. The retreating system is better adapted for the working of thick clean seams than the advancing system, as it requires no packwalls or gateways, and also where the seam is liable to spontaneous combustion, because the roof being always behind if a fire breaks out, the face is always receding further from it.

MATTHEW MOURLEY,
Rock Terrrace, Soothill Lane,
Batley, Yorkshire

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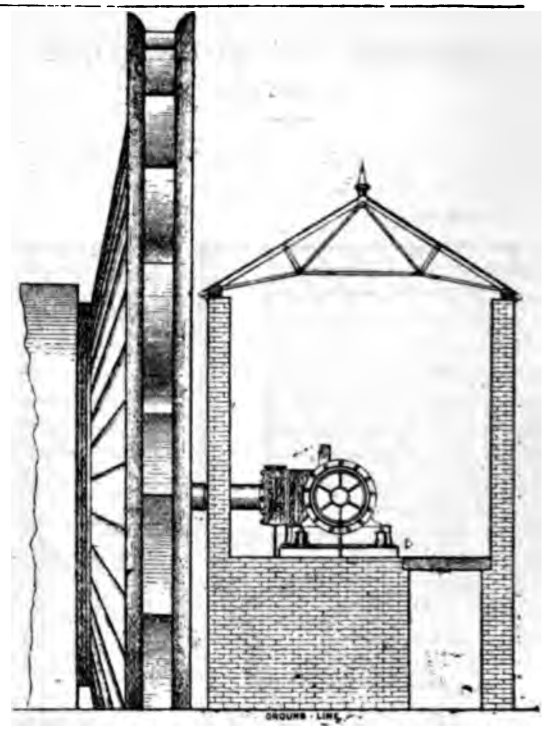
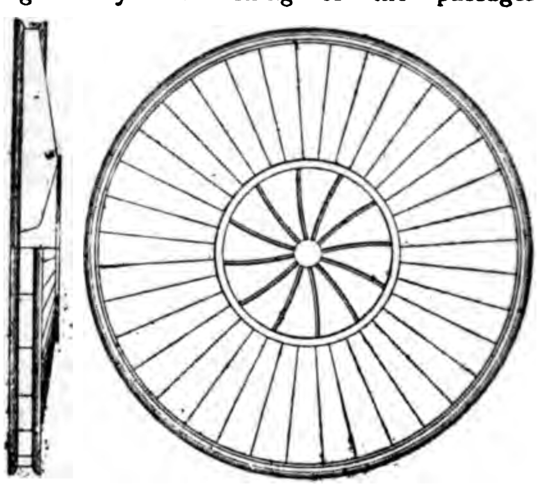
*Question* 4. (A.)—Describe, with sketch, the construction of the *Waddle* fan. Discuss its effectiveness.

*Answer.*—The *Waddle* Fan may be described as an open-running fan, not being enclosed in any casing or masonry, as in the case of the *Guibal*, *Capell*, &c., the air being discharged all round the periphery into the atmosphere. It has a bell-mouthed outlet which acts the same in principle as the evaseé chimney of the *Guibal*, by allowing



the air to expand so as not to enter the atmosphere at a high velocity, for if air entered the atmosphere at a high velocity it would be work wasted. The special points in favour of the *Waddle* fan are the backward curvature and inclination of the blades which allow the air to pass through the fan as easily as possible, the curved and gradually diminishing of the passages



which makes the diversion from the horizontal easy, and preserves uniformity of velocity. The diameter of the *Waddle* fan varies from ten to fifty feet, and the width at the periphery is regulated according to the capacity o the mine the fan is to ventilate. It is a

single inlet fan, always receiving the air on one side, and the large diameter and the high monometric efficiency render belt or other gearing unnecessary, so that the fan is invariably driven by having the engine coupled direct to the fan shaft, as seen in the accompanying sketch. A great improvement in the *Waddle* fan is altering the form of the blades, and lengthening them inside the inlet ring. The effect maintains equal velocities of air at every portion of the inlet.

The average efficiency of this fan as shewn by experiments, at speeds varying from twenty-nine to sixty-four revolutions per minute, was about sixty-five per cent. But the total work done by a fan is the work at the inlet plus the work at the final discharge, but all final work is to be deducted from useful effects. As to the quantity of air which can be circulated by this fan, by experiment, a fan forty feet diameter, running at fifty-two revolutions per minute, has produced 225,000 cubic feet of air per minute.

GEO. ROBINSON,
Bagthorpe,
Eastwood, Notts.

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*Question* 5. (A.)—Describe the principal methods used in working deposits of rock salt.

*Answer.*—Rock salt is worked by three systems generally, one system being that of boring two holes to the bed of rock salt, and and then forcing water down one hole by a pump; this dissolves the rock salt, which is pumped up the other bore-hole again as brine, run into evaporating pans, and evaporated. The second method is by sinking one or more shafts and driving headings and cut-throughs in the rock salt, leaving pillars to support the roof as in the bord and pillar system in coal mining. Then when the pillars have to be worked back, and the deposit is not too thick, they are removed by means of blasting. But, where the deposit is a thick one, it could not be timbered at such a height; but the best and cheapest way to get the pillars out is by directing a jet of water against the face of the rock. This dissolves the rock salt, and it is then run to the shaft in channels cut for the purpose, and pumped to the top. Another method of working rock salt where the deposit occurs at a moderate depth and the covering mass admits of being removed, is by surface working (quarrying). When the surface soil is removed and the deposit exposed, a cutting is made to the bottom of the deposit, where a ditch is made to convey away the water to a cistern to collect the *same. The work* is then carried on by descending steps. In this method great care has to be exercised to keep the breast or wall from caving in, thereby endangering the workmen.

THOS. BANKS,
7, Church Row,
Haydock, Lancashire.

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*Question* 6. (A.)—What are the disadvantages (if any) of using cast-iron tubbing in furnace shafts, and what would you do to overcome them?

*Answer.*—The disadvantages of cast-iron tubbing in furnace shafts is that the heat and sulphurous fumes decompose the iron by carbonising the surface, and rendering it unreliable. Sometimes the heat given off by a furnace causes the tubbing to expand unequally, thereby causing it to crack. The sulphurous fumes given off by the furnace combine with the water, forming sulphuric acid which eats away the tubbing and also the wooden sheathing, thus rendering the tubbing useless. The sheeting and wedging being practically boiled, the result is the resinous matter is dissolved, and the fibres of the wood are parted and become simply a mass of pulp, so that at intervals of a few weeks the tubbing is always spouting. To prevent this I would have the tubbing cast with inside flanges into which I would build fire-bricks, cemented together thinly with hydraulic cement, each joint being crossed as in ordinary walling. I would leave the vertical and horizontal joints open for examination in case of leakage. Coating the tubbing with tar or paint has been tried and found to give very good results.

GEO. ROBINSON,
Baythorpe,
Eastwood, Notts.

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*Question* 7. (H.)—In preparing a self-acting incline, how would you arrange the gradients at the top and bottom of the plane?

*Answer.*—In laying out a self-acting incline I would be careful to make the gradient at the bank-foot less than any other part of the incline, and I would make the gradient at the bank-head the greatest. The reason why I would do this is, in addition to having the empty tubs to haul up the incline, there is also the weight of the rope to haul up. Besides, there is also the inertia of the tubs and rope to take into account, and also the friction of rope, so that in order to have an efficient self-acting incline it would be necessary to raise the top of the incline and

have it higher than the ordinary grade of seam by ripping away part of the roof and laying the road over the top of the debris, thus making the gradient greater; and by ripping part of the bottom at the foot, or a part of the top, and laying the road over the debris, thus making the gradient less.

WILLIAM ROBSON,
126, Church Street,
Walker-on-Tyne.

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*Question* 8. (H.)—Describe the method of sinking a pit through water-bearing strata, having very soft ground to commence with. Give dimensions of the materials you would use for a sixteen-feet pit.

*Answer.*—One method of sinking through water-bearing strata, having soft ground to commence with, is that known as pile sinking. Wood planks, fifteen feet long, six inches broad, and three inches thick, shod with iron and sharpened at the driving end, are driven vertically downwards so as to form a circle so much larger than the intended finished size of the shaft as will leave room for successive inner circles of piles down to where solid ground is expected to be found. To keep the piles in position and prevent them crushing in, oak cribs, six inches deep and formed of segments curved to suit the sweep of the shaft, are fixed about three feet apart, inside the piles, as the debris is dug out. At three feet from the bottom another set of piles is driven down within the cribbing and supported within by cribs, in a similar manner to the first set. This process is continued until the stonehead is reached, when a walling crib is laid and the walling built up, the space between the piles and walling being packed with clay. It will be seen that each fresh set of piles reduces the diameter of the shaft by twice the thickness ef the cribbing and piles (in this case eighteen inches), so that for a depth of 120 feet the diameter would be reduced $18 \times 10 =$ 180 inches, or 15 feet. Therefore, the initial diameter of the shaft would have to be double the finished size, to allow for piling and walling. This method of sinking is very difficult and costly, and is only adopted when no other suitable position for the shaft can be found. For an illustration of this method see page 231, in Vol. 1, No. 20, of "Mining."

SAMUEL THORPE,
Chevet View, Ryhill,
Wakefield.

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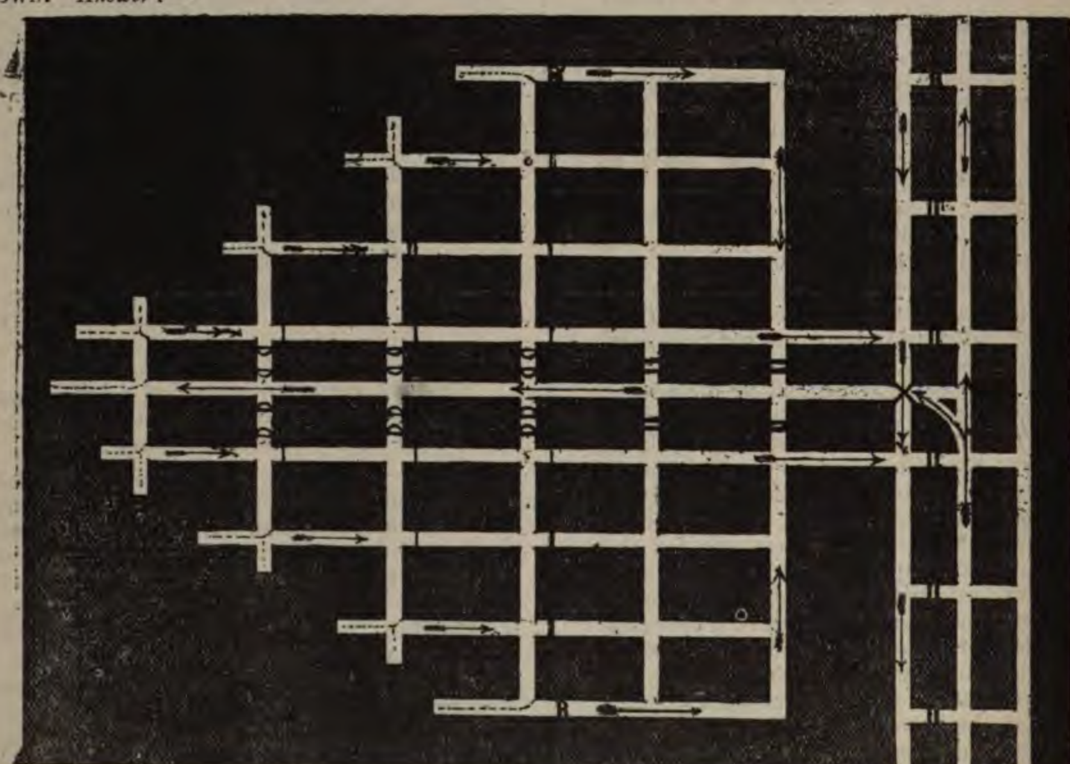
*Question* 9. (M.)—Give a sketch of a full-sized district of bord and pillar workings, showing how the air is taken round the face. All stoppings, crossings, regulators, sheets and doors to be shown. *Answer :—*



*JOHN* LAVERICK, Eppleton Colliery, R.S.O., Co. Durham.

*Question* 10. (M.)—What are the regulations of the Mines Act as to hours of boys above and below ground, fixing of machinery, precautions in approaching old workings, refuge holes? (State in own words.)

*Answer.*—In the C.M.R.A. it will be seen that boys (which means of the age of twelve years to sixteen years) must not be employed more than fifty-four hours in the week. The week commences at midnight on Saturday, and ends on the following Saturday. Every boy must have a rest of twelve hours between two shifts of work, except between Friday and Saturday, when eight hours will suffice; also no boy must work more than ten hours a day. (Day commences when leaving surface to the time when arriving at the top again.) No boy must work more than five hours a day without an interval of half-an-hour, or more than eight hours without one-and-a-half hours interval.

When fixing machinery every part where needed shall be so made as to have brakes, indicators, and if the drum is not on the crank shaft, there shall be an adequate brake on the drum shaft. Also every fly-wheel and all parts exposed shall be securely fenced.

When nearing a place where an accumulation of water is expected, that road shall not exceed eight feet in width from a point forty yards to such a place, and one bore-hole must be kept in advance in the centre, not shorter than five yards, and sufficient boreholes must be kept at the sides.

When a plane exceeds thirty yards in length, man-holes must be made at intervals of twenty yards, if there is room for persons to stand between the sides and the tub, but if not (and worked by machinery with the exception of endless rope or chain), not more than ten yards apart. When roads are worked by horses, man-holes must not exceed fifty yards apart, and every man-hole must be kept clear, and must be three feet from the wagons to the side.

MATTHEW CHAPMAN,
17, Kiveton Park, Sheffield.



## PRIZE COMPETITION.

### QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by December 9th, 1893.

*Question* 1. (E.)—State the objections to the plan, which has been sometimes suggested, of ventilating the goafs of collieries by bore-holes from the surface?

*Question* 2. (E.)—What are the circumstances under which gunpowder for blasting may be put in loose, or should be in cartridges? Compare the two methods.

*Question* 3. (E.)—What measures may be taken, without introducing machinery, exciting a ventilating current, to improve the air in a particular district in a mine?

*Question* 4. (A.)—What is a steam engine, and what is the principle of its action?

*Question* 5. (A.)—Sketch neatly in ink, to a scale of one inch to a foot, a plan and elevation of a trap-door for a horse-way.

*Question* 6. (A.)—What diameter must a circular pit be to have the same area as an oblong one, which is nineteen feet by six-and-a-half feet.

*Question* 7. (H.)—Describe with sketch the *Guibal* Fan, and discuss its effectiveness.

*Question* 8. (H.)—In sinking with a rock drill describe all the arrangements you would make for applying it to its work, and what precautions you would take for its protection while blasting. Give your opinion under what circumstances it becomes most serviceable, and whether it forms an efficient tool in facilitating sinking operations.

*Question* 9. (M.)—A ventilating fan running at forty-five revolutions per minute produces a water-gauge of 1·75 inches. What will the water-gauge be if the fan speed is increased to sixty revolutions per minute?

*Question* 10. (M.)—What is meant by good discipline in a colliery, and what efforts would you make to maintain it?

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.

Envelopes to be marked "Correspondence."

Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### The Colliery Fireman.

Wigan,
November 18th, 1893.

*To the Editor of "Mining."*

Sir,

On looking over your Journal of November 16th, 1893, I noticed that there was a little correspondence going on respecting the qualifications requisite in order that a person may discharge the duties of a colliery fireman in accordance with the Coal Mines Regulation Act, of 1887.

I myself have heard about persons being employed as firemen who could neither read nor write, though I doubted the truthfulness of the statement, for I fail to understand how a person can discharge the duties of a fireman who can neither read nor write. For instance, if the fireman finds such a quantity of gas in a place that he has to withdraw the workmen, (Rule 29, of the special rules in force in this district, specifies that "he shall enter a record of the same in his report book, and also in the sudden danger book.") If he cannot write he cannot possibly comply with the C.M.R.A., and is not a competent person as required by the Act. I may say that I have had the pleasure of being in the company of a goodly number of firemen in this district and I have not yet seen a single person who, being employed as a fireman, could not read or write. If there are any such persons they must be very few and very far between. I am in favour of a clause being inserted in the Coal Mines Act requiring a person to pass an examination and obtain a certificate before he can occupy the responsible position of a colliery fireman. He ought certainly to be able to make an intelligent report of the state of the workings. There are report books in use at some collieries in which the fireman only needs to write "good," "safe," "in working order," and then sign his name, *that is, supposing* everything to be safe and *in working order.* I am not at all in favour of this class of report books. I think the fireman should make a report in his own handwriting of the condition of his district of the mine. Below will be found a specimen of a report recorded by the fireman at a colliery in this district, which I consider very good.

| Date. | Name of Mine or Colliery. | Condition in which found. | Time. | Signature. |
|---|---|---|---|---|
| 1893. Nov. 18. | —— Mine | All working places and drawing and travelling roads free from gas. Roof and sides good. Timber and ventilation good, and man-holes clear .. ... | 4 a.m. | John —— |
| Nov. 19. | —— Mine | James ——'s place slightly on weight, and is fenced off. There was a little gas in Samuel ——'s higher side ——. This has been removed, and the place is now safe. All working places (except James ——'s) being now safe and free from gas. Roof and sides good. Timber and ventilation good and manholes clear. | 6 p.m. | John —— |

Hoping to have the opinion of others of your readers,

I remain, yours truly,

"Firo."

*To the Editor of "Mining."*

Dear Sir,

Being a subscriber of your valuable paper, and being interested in the principles of mining generally, I take the liberty of asking a question which I hope some of your more enlightened readers will answer:—

Describe how to timber a shaft (metal mine).

I work in an iron ore mine myself, but I have never had an opportunity of learning much with regard to sinking operations. What I want to know more particularly is:— Suppose you were commencing to timber a shaft, and put what is called the frame on first and levelled it, and say you wanted to put in three courses, *i.e.*, rounds of timber, with eighteen-inch studdles or corner uprights, how would you know the exact depth to put in the bottom round so that the four top-straddles would fit exactly under the frame? I would also like to know how to get it exactly plumb; of course I partly understand that this is done with lines.

Yours sincerely,

James Williams.

(We will award the usual Prize for the best Answer to the above.—Ed.)

*Printed and Published by* Strowger and Son, Clarence Yard, Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MINING STUDENTS.

No 2. Vol. II. SATURDAY, DECEMBER 16, 1893. FORTNIGHTLY. ONE PENNY.

CONTENTS.



## EASY LESSONS ON MINE SURVEYING

### For BEGINNERS.

WHY SURVEYING IS NECESSARY AND ADVANTAGEOUS.

SURVEYING is that science which enables us to represent in minature on a plan the surface of the earth or the workings of a mine. According to the C.M.R.A., the underground workings of every mine must be constantly recorded and carefully put on a plan of the estate about to be wrought. This plan of the estate is taken by experienced engineers, and embraces all landmarks, such as farm steadings, cottages, roads, rivers, plantations and lakes; even single trees and the hedges of fields with their gates, together with the boundary of the estate distinctly edged with color, are all carefully and accurately laid down on this surface plan, and handed over to the manager of the mine about to be wrought, when he, himself or the person appointed to make the underground surveys, then places the position of the shaft on this plan, and as the workings of the mine advances underground, he adds the relative position of every working place, step, dyke, or other fault, found below in course of the ordinary operations, and it must at no time be found to date back more than three months. When the workings are thus kept up to date, it can be seen at a glance where any particular working place, drift or fault is, compared with any particular spot on the surface, or advancing on the boundary of the mineral field of the estate; or should there have existed at any previous time other mineral workings of any description, and which has every chance to lie full of water or dangerous gases, it is of the greatest importance to know, or at least have some idea of their whereabouts, and for which rules are provided by the C.M.R.A. to ensure the safety of the workmen below in all such cases, by keeping bore holes constantly advancing in front and also on each side of the foremost level heading or dook, thus guarding against any

sudden outburst of either water or gas from old workings, of which perhaps no reliable record has been kept. Another matter which is of great importance is the leaving of pillars when necessary to support buildings, etc., on the surface. Without an accurate survey of the mine and the estate under which it is worked, it is impossible to leave such protection, and the damage done to the property will be in most cases such as to cause considerable expense and anxiety to the colliery proprietor. Again, when a mine is to be wrought a lease is taken of the mines under such lands or estate as is calculated to be worked, and if the minerals of an adjoining estate not in lease be worked it produces dispute, and usually results in an arbitration or law case to decide what recompense must be paid for such encroachments. Irrespective of these financial difficulties and loss of life which would probably occur without the knowledge supplied by surveying, there are many improvements in the actual working of the mines which could not be effected without the aid of a survey, and anyone taking part in the management of a mine will no doubt recall many instances of important improvements having been made by reference to the plan of the mine, etc. Sometimes it is advantageous to drive a tunnel from one particular point to another, perhaps to form a new haulage road to replace the old roundabout road, or to lessen the course of the ventilation, or to sink pits or drive tunnels from one mine to another, and the direction and gradient of such proposed roads can be easily determined from the plan or by a separate survey.

*(To be continued.)*

# HAULAGE.

## Chapter III.

### Horses, Self-acting Inclines, &c.

IN an extensive colliery the tubs may pass through various systems of haulage before their arrival at the shaft. The tubs are "hurried" or "drawn" from the coal faces in the first instance to the main haulage roads by men or boys, who are termed "drawers" or "putters," after which they may be conveyed to the shaft by one or more of the various haulage systems. When the distance from the coal face to the nearest haulage roads exceeds from one to two hundred yards, another haulage road is driven to cut off the drawing roads, as the men will not draw the tubs more than a certain distance, and this distance varies according to the custom in different localities, and the nature of the roads; independent of this, the extra allowance which will be demanded by the men for long drawing, will make it far cheaper to construct new main haulage roads about every one hundred yards.

The other methods of haulage employed after the tubs have left the hands of the putters, are:—

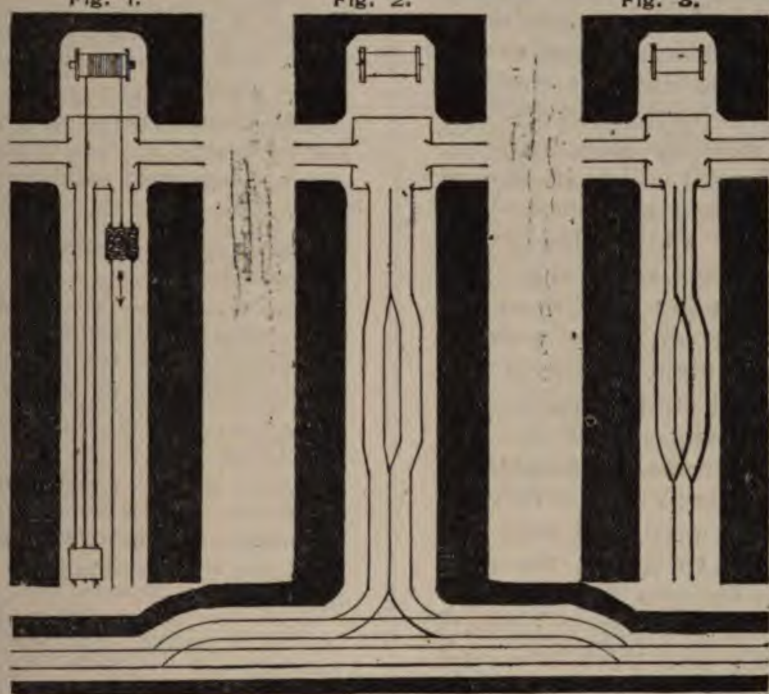
1st—Horses
2nd—Self-acting Inclines
3rd—Direct
4th—Main and Tail Rope
5th—Endless Rope or Chain

Horses are for the most part employed on comparative flat roads as in the main levels of a mine. Horse-roads are usually laid out similar to our tramways on the surface, viz.:—with pass-byes at intervals to allow for the passage of horses going in different directions; but where the output is large a better

plan, if the roof is sufficiently strong, is to have a double line of rails throughout the whole of the road, as considerable time is wasted in waiting for the arrival of one horse so that it may pass the other at the junction. When the roads are a fair height, kept in good order, and the exchange of empty tubs for full ones is properly regulated, horses give good results.

In cases where the full tubs have to be conveyed from the rise side of the shafts and the inclination exceeds about 1 in 30, the full tubs in descending towards the shaft may be utilised to haul up the empty ones from the bottom of the incline; if the road is not in comparatively good order and the gradient properly arranged, the inclination will require to be greater than 1 in 30, as it is only with the most favourable circumstances that this inclination is sufficient. The road in which this method of conveying the *coals is adopted,* is known *as a "jig-brow" or self-acting* incline (three of which are shown in Figs. 1, 2 and 3), according to local conditions and circumstances, but the general principle will be understood by reference to Fig. 1. In the plan is shown a full tub at the top of the brow in the act of descending, and by means of a rope attached to the coupling of the tub passed round the drum (a wheel is sometimes used) at the top of the brow returning down

Fig. 1. Fig. 2. Fig. 3.



the length of the plane and attached to the coupling of the empty tub, the empty tub is drawn to the top of the brow by the force of gravity acting on the full tub. A brake is fitted to the drum and is worked by an attendant ("jigger") to prevent the tubs from running at too high a speed where the inclination is great, or to stop them when required. We have shewn one full and and one empty tub in the figure, but it is usual to run a good number in each journey.

In Fig. 1 double lines of rails are laid throughout the plane, but in many cases the nature of the roof is such as to render this method

impracticable, though it is by far the best, as there being no curves the tubs can be run at a high speed without leaving the rails. In Fig. 2 is shown an arrangement whereby one length of rails is dispensed with except at the junction. The three lines of rails are laid so that the inner one with either of the outer ones will form the correct gauge for the tubs, the inner line thus being used by both the full and empty tubs, as it will be easily understood that both gauges at any end of the plane will not be used at the one time, the only portion where the tubs will be side by side being in the centre, where it will be necessary to form a junction or pass-bye as shown in sketch. On the lower part of the plan is shown an arrangement for running the tubs to and from the main line to the pit. Fig. 3 shows another arrangement whereby the width of the road, and consequently the cost of maintenance is still further reduced; this is accomplished by laying the rails in such a manner that the gauge is made not with the next line of rails to it but the next but one; thus the two lines overlap each other, and one pair of rails is shewn in sketch with thick lines and the other with thin lines; the junctions are formed in the ordinary manner; below the junctions only one set of rails are shown, and the arrangement for allowing the full tubs to come down and the empty ones to go up the other side may be made in several ways; it may be made so that the descent of the full tubs pushes the rail in the proper course for the next gang, or by a special joint of the rails at this point, which is made a little higher on the side for the full tubs or descending side, so that the other side is the easiest course for the empty tubs to take.

*(To be continued).*

## PRIZE COMPETITION.

### QUESTION PRIZES.

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4th—They must reach us by December 23rd, 1893.

*Question* 1. (E.)—Describe, with sketch, the Meuseler Lamp.

*Question* 2. (E.)—What is cannel coal, and under what conditions is it generally found?

*Question* 3. (E.)—What are minerals as the term is understood by miners?

*Question* 4. (A.)—Describe, with sketch, the Capel Fan.

*Question* 5. (A.)—Explain the theory of the ventilation of mines, and what are the advantages of large air-ways?

*Question* 6. (A.)—Find the square root of 994,009.

*Question* 7. (H.)—Plot on paper (in ink), to any scale, the following survey:—

| | | | |
|---|---|---|---|
| N. | 85 | W. | 665 links. |
| N. | 41·15 | W. | 705 „ |
| N. | 21·30 | W. | 950 „ |
| N. | 44·45 | E. | 522 „ |
| S. | 69·30 | E. | 800 „ |
| S. | 12·45 | E. | 1605 „ |

*Question* 8. (H.)—In obtaining information from old plans what precautions would you take, and how would you form an approximate idea of its date?

*Question* 9. (M.)—Describe the bricking scaffold you would use in a sinking pit. State how you would support it when in use, how you would raise and lower it, and what you would do with it when not in use.

*Question* 10. (M.)—If accumulations of explosive gas or other poisonous gases should be met with in a mine, what steps would you take?

# EXAMINATION QUESTIONS,

**With Answers, by**

**THOS. FLETCHER, First-Class Certificated Manager**

The following questions for the examination of Candidates for Certificates of Competency were set in the Manchester District, 1890.

## FIRST-CLASS CERTIFICATES OF COMPETENCY.

*(Continued from last issue.)*

### Coal Mines Regulation Act, 1887.

QUESTION 13.—What persons have their hours of Working limited by the Act, and what are the limits in each case?

ANSWER.—Girls, women, and boys have their hours limited. The limit for boys (from thirteen to sixteen years of age), girls, and women is not more than fifty-four hours per week; not more than ten hours per day, and not at night from nine p.m. to five a.m., nor on Sundays, nor after two p.m. on Saturdays, and shall have an interval of twelve hours between shifts, with the exception of the interval between Friday's and Saturday's shifts when eight hours will suffice; and must not be employed more than five hours without half-an-hour for a meal, nor for more than eight hours in a day without intervals of at least one-and-a-half hours for meals. Boys and girls twelve years of age and under thirteen not more than six hours a day if employed more than three days a week, nor more than ten hours a day if employed for less than three days per week; the intervals for meals being the same as the previous one. Below ground boys from thirteen to sixteen are not to be employed for more that fifty-four hours per week nor ten hours per day, with intervals of twelve hours between shifts, except the interval between Friday's and Saturday's when eight hours will suffice.

QUESTION 14.—In erecting a ventilating fan or furnace, what points must be attended to in order to comply with the Act?

ANSWER.—In erecting a ventilating fan, it is necessary to place it in a position which will tend to ensure its being uninjured in the event of an explosion occurring. When a fire or furnace is used the return air must be carried off clear of the fire by means of a dumb drift, unless it be not inflammable.

QUESTION 15.—Enumerate the matters which must be notified or reported to the inspector of the district.

ANSWER.—The matters to be notified to the inspector are:—Notice of Manager's name and address; by January 21st, every year, the annual return, stating for the previous year ending 31st December, the number of persons ordinarily employed, the quantity of days in each month in which coal or iron-stone was raised, and all particulars respecting the ventilation of the mines. Notice of loss of life or any personal injury, by any accident whatever, to be sent within twenty-four hours after the occurrence, and to state the character of such occurrence and the number of persons killed or injured. Notice of any death resulting from such personal injury to be sent within twenty-four hours after the owner, agent, or manager knows of it. Notice of commencing a working to open up a new shaft or seam, of abandoning or discontinuing the working of a shaft or seam, of recommencing to work a shaft or seam after being abondoned or discontinued for more than two months, and of any change in the name of the mineowner, agent, or manager, or in the principal officers of any incorporated company owning the mine, within two months after the event. A report of the result of any proceedings against workmen for breach of the Act to be sent within twenty-one days of the hearing of the case. If a report of an inspection on behalf of the workmen be made, and any danger is said to exist or is apprehended, Gen. Rule 38 states that a true copy of the report must be sent without delay.

QUESTION 16.—Enumerate all the points to which you would direct your attention in order to ascertain that the requirements of the Act were fully complied with in regard to a winding shaft, including the ropes and chains.

ANSWER.—First I would see the reports and ascertain if the machinery, etc., were examined every twenty-four hours, and the shaft once per week; that the top and every mouthing, including surface, was securely fenced; that there are signals from every mouthing in work to the surface, and from the surface to every mouthing in work; that the shaft, sump, and all places below scaffolds be well ventilated; and (if no safety hook is used) that the cage does not exceed the speed stated in Special Rule, viz.:—three miles per hour after reaching a certain position (twenty yards from top) in the shaft, when men are being raised.

QUESTION 17.—What are the requirements of the Act as to plans?

ANSWER,—An accurate plan must be kept at the office of the mine, showing the workings up to a date not more than three months previous, the general direction and rate of dip of strata; also a section of the seam. Scale to be not less than twenty-five inches to a mile.

QUESTION 18.—Are the dimensions of any roads limited by the Act? If so, what are they?

ANSWER.—The communication between shafts must not be less than four feet high and four feet wide, except under certain conditions in low mines, by permission of the Inspector. Horse-roads or roads used by animals must be of a size sufficient to allow of the passage of the animals without rubbing roof or sides.

(*To be continued.*)

## NOTICES.

We are sorry that the Illustration for the Index and Engraved Title for the title head did not appear in last number. This was owing to some mistake on the part of the engraver as to the date upon which they would be required, and they did not come to hand at time of going to press.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Literary communications to be addressed to the Editor, "Mining," Clarence Printing Works, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

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# GLOSSARY OF MINING TERMS

### (NORTHUMBERLAND)

COMMUNICATED.

Continued from No. 26.

**Flatter**—The boy who couples and uncouples the tubs on the flat.

**Follen**—Topstone that follows in the coal.

**Fore-overman**—The overman who enters the mine first every day.

**Fore-shift**—The first set of men that commence in a day.

**Fore-pillar**—The pillar in a pack which runs on a line with the gate road.

**Furnace**—A large fire placed at or near the bottom of an upcast shaft for ventilating purposes.

**Furnace-drift**—A drift rising from the surface to the upcast shaft.

**Furnace-man**—The person who looks after the furnace.

**Fuse**—A train of gunpowder enclosed in calico tape, covered over with gutta-percha, for firing an explosive.

**Galloway**—A small pony.

**Gan-bord**—A bord used for haulage, off which branches several headings or walls,

**Gangway**—An incline from the heap-stead to the ground, used for hauling anything on to the heap.

**Gates**—For protecting the entrance into the shaft.

**Gate-ways**—In longwall working, the working places that are driven at right angles to the direction of the cleat of the coal.

**Gear**—The whole of a miner's tools are called his gear.

**Glut-ends**—Wood wedges that are driven between a balk end and the side of a level.

**Goaf**—That part of a mine where the coal has been worked out and the roof allowed to fall.

**Hack**—A heavy pick used for stone work.

**Hauling**—The conveying of coal in tubs from the working face to the shaft bottom.

**Heading**—A working place driven end-way to the direction of the cleat of the coal, and at right angles to a gate-way.

**Head-tree**—A piece of wood placed between the roof and a prop.

**Heap-stead**—The surface platform for landing the tubs, &c., from the cage to be emptied into the screens.

**Hewer**—The person engaged in getting the coal in a mine.

**Hitch**—A rise fault.

**Hole**—The entrance into the shaft from the ground.

**Holed**—When one working place cuts into another it is said to be holed.

**Hopple-trot**—The endless rope system of haulage.

**Horse-keeper**—The person who attends to the horses.

**Incline**—That part of a haulage road where the full tubs pull the empties up by means of a rope.

**Indicator**—The bell which signals to the brakesman the position of the cage in the shaft.

**Intake**—The inward passage of the air to the workings.

**Jack-roll**—A machine for raising material by manual labour.

**Jenking**—A narrow place driven up the middle of a pillar of coal.

**Jockey**—The clip for carrying the rope in endless rope haulage.

**Jowling**—A system of knocking the coal or stone to ascertain its hardness or thickness.

**Jumper**—A tool for drilling a hole.

**Junction**—The union of two roads.

**Kecker or Keeper**—The overseer of the workmen engaged about the pit at the surface.

**Keeps**—For resting the cage on when the tubs are being changed at the surface.

**Kick-up**—The apparatus for overturning a full tub when being emptied into the screen.

**Lamp-man**—The man who trims and cleans the lamps used in a mine.

**Landing**—The end of an engine plane.

**Ledden**—The tub that stands in a working place to be filled while the putter is at the flat for an empty one.

**Lift**—A slice of coal taken off the side of a pillar of coal in broken work.

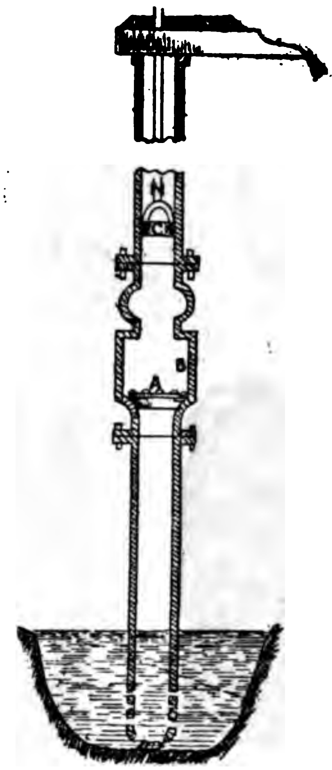
**Lifting-dog**—An instrument for fixing on bore-rod when lifting them.

**Limbers**—That which a horse or pony is yoked into for connecting them to the tubs. (*To be continued.*)

## ANSWERS TO QUESTIONS

**In No. 26.**

*Question* 1. (E.)—Explain, with sketch, the mode of action of a common lift pump.



A Clack C Bucket
B Door N Rods

*Answer.*—Its mode of action is as follows:—When the engine makes a downward stroke the air between the bucket A and the clack B is forced up the pump, on account of its not being able to escape through the clack, it being airtight and unable to open down after the bucket has completed its stroke. On the up-stroke the bucket falls and forms a vacuum above the clack B, and this space is then filled up with water rising through the wind-bore D, and the clack falls by pressure of the atmosphere on the surface of the water outside the pump in the sump or cistern. When the bucket descends again the water forces its way through the bucket and forces the clack falls close. When the bucket reaches the extent of its downward stroke, the weight of the water closes the falls, and on the upward stroke lifts it to the surface.

ALBERT HY. MEAKIN,
Mansfield Road,
Eastwood, Notts.

*Question* 2. (E.)—Of what use are fossils, and which would lead you to consider that coal would exist in the locality in which they were found?

Fig. 1.

Pecopteris.

Fig. 2.

Neuropteris.

Fig. 3.

Calamite.

Fig. 4.

Sigillaria.

Fig. 5.

Stigmaria.

Fig. 6.

LEPIDODENDRON.

Branch. Bark. Fruit.

*Answer.*—The use of fossils is of great service in mining, perhaps more so in mining than any other branch of labour. They point out where we may expect to find coal or any other useful mineral, not only in our own country, but also in other countries. Some formations have fossils peculiar to them, and if I was examining rocks and found a fossil peculiar to the Carboniferous formation I would suppose it possible to find coal there, while on the other hand if it was a fossil peculiar to the Silurian formation, I should never think of searching for coal. By a thorough knowledge of fossils and their peculiarities we may save ourselves a large amount of time, labour, and expense, when in the act of searching for coal, &c. The fossils which indicate the existence of coal in any locality are the fossil plants described as under:—Pecopteris, Neuropteris, Calamites, Stigmaria, Sigillaria, and Lepidodendron; these are the chief flora plants which indicate the existence of coal. It would be foolishness for a person to search for coal without first having a knowledge of the geological formation of the country where he was about to make his search,

WILLIAM HUNT,
Darton,
near Barnsley

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*Question* 3. (E.)—Describe, with sketch, the Marsaut Safety Lamp.

*Answer.*—The Marsaut Lamp is constructed with two conical gauze cylinders which are made to fit closely together at their bases on the top of the glass cylinder, and these gauzes gradually leave one another as they rise upwards. The gauzes are shielded by a bonnet of sheet iron screwed on a flange above the glass cylinder. The air by which the flame is fed passes through a number of apertures near the lower end of the bonnet, extending along the copper band with which the large and outer gauze is terminated below. At the top of the bonnet, just above the gauze and below the circular plate of the lamp, are a series of outlet holes through which the products of combustion escape. With two gauzes the illuminating power is about two- thirds of a standard candle.

W. T. HEWITT,
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*Question* 4. (A.)—Describe the lime cartridge method of breaking down coal.

*Answer.*—The lime cartridge method of breaking down coal is as follows, viz.:—

Ordinary mountain limestone is calcined (burnt) and ground to a fine powder, and compressed by hydraulic power into a cartridge having a grove running along its full length. The cartridge is about five inches long, and two-and-a-half inches in diameter. When taken from the press it is wrapped up in a sheet of paper, and placed in an air-tight box to keep away all damp. The coal is holed or kirved, and shot-holes drilled in the ordinary way, and cartridges placed in them. A small tube half-an-inch in diameter, having a small external channel on the upper side and provided with holes, is inserted along the full length of the hole. Sometimes several cartridges are placed in each hole, the grooves formed in them during the process of manufacture laying upon the tube just referred to, and the mouth of the hole is tamped in the usual way. A small force pump is then connected by suitable means to the end of the tube projecting from the hole, and water forced in. Then the pump is detached and carried away elsewhere. The water acting on the lime expands its bulk to about five times its original size and thus forces down the coal in a few minutes.

The advantages claimed for the lime cartridge are:—(1) Absolute immunity from explosive gas, there being no fire or flame. (2) There is no unpleasant smell. (3) The roof is not shaken. (4) The coal in falling makes less small coal and dust.

The disadvantages of the lime cartridge are:—(1) It is easily spoilt and rendered useless from a damp atmosphere. (2) It requires a large hole to be drilled. (3) If there is a break or back in the coal it goes into it, and thus leaves the coal up standing. (4) It often blows the stemming out into the men's eyes which I have known it to do with great violence. There are not many managers who speak with much hope of it ever coming to the front as a leading agent in getting down coal.

JOHN COOK,
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*Question* 5. (A.)—Describe the various arrangements adopted for guiding cages in a shaft, when drawing at a high speed.

*Answer.*—The arrangements for guiding or conducting cages in the shaft may be described under two heads, viz.:—Rigid and Flexible. Rigid conductors of iron or wood, and flexible after the manner of wire ropes. In some of the Lancashire collieries the shafts have been fitted with a continuous round bar of iron, fixed at the bottom of the shaft. The top of the bars or rods are screwed up to the headgear. The cross-bar of the cage has a ring at each end, which runs upon the rods. Vertical iron rails are sometimes used, keyed on to chairs attached to buntons or horsetrees, and on each side of the cage grooved wheels are attached, which run upon the rails. In some collieries wood conductors are used, generally made of pitch-pine about four inches square, up to twenty-four feet in length, attached to each side of cageway, secured to buntons or horsetrees with iron set-screws with the heads countersunk, to allow the cage a free passage. On each side of the cage, top and bottom, iron shoes are attached which fit on to three sides of the conductor. The shoes are a little bell-mouthed upward and downward to allow them to slide easily. Flexible conductors are made of stout iron wire ropes secured at the top of the headgear with strong wrought-iron clams—say one pair of clams for every one hundred fathoms in depth. These clams grip the conductor, and rest upon bearers at the top of the head-gear, and at the lower end, in the sump-hole, is attached a solid circular weight of iron which keeps the conductor vertical, and is kept in position by being passed through a small iron fastening fixed to each side of the sills. Sufficient clearance should be allowed to prevent the weight from resting on the bottom. Slide boxes are attached to the cage, top and bottom, which fit round the conductor. You may have two, three or four conductors to each cage, but in all cases there should be two conductors between the cages as the middle conductors prevent the cages from coming in contact by oscillation when moving in the shaft. The advantages claimed for flexible conductors such as wire ropes are:—That they are easily fixed and seldom get out of order, they cost less than rigid conductors, and require less repairs; they provide for contraction and expansion, they give ease and comfort to persons riding in the shaft, are serviceable when winding at a high velocity, the friction is reduced to a minimum, and it is not necessary to weaken the shaft by fixing horse-trees.

JAMES BURROWS,
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Dalton-in-Furness.

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*Question* 6. (A.)—Describe the Lanarkshire Coalfield.

*Answer.*—The Lanarkshire Coalfield is the largest and most important field in Scotland, containing some very rich coal. The field

extends from Glasgow to Lesmahagon, a distance of nearly twenty-five miles, running nearly due north and south. Its average breadth is about seven miles, or occupying a total of nearly 150 miles. The coal varies greatly in thickness, but very little in quality. There is about fifty feet of good workable coal, and the coal is overlaid by the New Red Sandstone, which attains a great thickness. There are about thirty seams of coal in the field, but not more than seven or eight have been worked in any one colliery. At Hamilton, Motherwell, Blantyre, etc., the following are the chief seams which are worked:—Ell, Main, Pytoshaw, and Splint Coals. In Glasgow district the Upper Coal, Humph, and Splint Coal seams are worked. As stated above the seams vary much in different places. Upper Coal at Glasgow is four-and-a-half feet, while the same seam of coal, six miles distant, is one-and-a-half feet thick. Ell Coal at Hamilton is seven feet thick, and the same seam at Letterick Colliery, Blantyre, two miles distant, is three feet thick. The depth of the seams also vary much. At Ross Colliery, Hamilton, the Ell coal is found at a depth of one hundred and thirty-five yards; at Bardyke's Colliery, Blantyre, four hundred yards; Hallside Colliery, Newton, five hundred yards; this is the deepest point reached. The distance between Hallside Colliery and Ross Colliery is about seven miles. There are two very large faults between these two collieries, each nearly one hundred fathoms of an up-throw and downthrow respectively. They run N.E. to S.W. A great many smaller faults are found throughout the coalfield, varying from a few feet to fathoms. The whole of the seams worked give off a good deal of fire-damp, the Ell and Splint coal especially. At some collieries they have a great deal of water to contend with, while other collieries have very little or no water. Taking the coalfield throughout there is a great quantity of water which gives very much trouble. The most important mining districts in the Lanarkshire coalfield are:—Hamilton, Blantyre, Cambuslang, Larkhall, and Motherwell. In all these districts large quantities of coal are raised.

JOHN H. RONTREE,
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near Barnsley.

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*Question* 7. (H.)—What precautions should be adopted in working a colliery liable to sudden outbursts of gas?

*Answer.*—The precautions are numerous, and should all be with an eye to the safety of the workmen and the mine.

VENTILATION.—So far as it is practicable a furnace should not be used. A fan is much safer as the liability of an explosion by the furnace fire at the bottom of the up-cast is nil, and the fan is much more secure in case of an explosion, owing to its being at the top of the up-cast. Each district should have a sufficient quantity of fresh air direct from the downcast, with a separate intake and return. The splitting should commence near to the bottom of the down-cast, and the respective currents should unite again near the bottom of the up-cast. All air-crossings and stoppings should be built air-tight and strong to withstand the blast of an explosion. All doors should be hung so that they will fall close of their own accord, and all doors immediately connected to the return should be locked when persons do not travel that way. Outbursts in the in-take should be conducted directly into the return, and not allowed to go into the workings.

FIREMEN.—Persons whose duty it is to examine the workings, etc., should be thoroughly competent and able to understand the barometer and its reading. Each fireman's district should not extend to any great length so as to allow him time to make frequent inspections during his shift.

LIGHTS.—No lights except those of locked safety lamps should be used in the mine, and should be trimmed, examined, and tested at the surface by a competent person each time it is entering the mine.

EXPLOSIVES.—No explosive should be used except those of the flameless class, and only very sparingly—just in cases of necessity—and taking care to carry out the C.M.R.A. The barrier bord and pillar method of working would be the best to adopt if circumstances allowed.

JOHN GRAY,
Glebe Row, Bedlington,
Northumberland.

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*Question* 8. (H.)—Describe, with sketch, the *Mather and Platt* method of deep boring.

*Answer.*—A boring bar about four inches diameter and eight feet long, at one end of which a cast-iron block is secured, is suspended by a flat wire rope, half-an-inch thick and four-and-a-half inches broad, from a drum ten feet diameter, and passes under a guide pulley, through a clam, and over a pulley three feet diameter fixed over the borehole. The percussive motion is produced by a steam cylinder fitted with a fifteen-inch-diameter piston having a cast-iron rod, seven inches square, branching off to a fork in which is

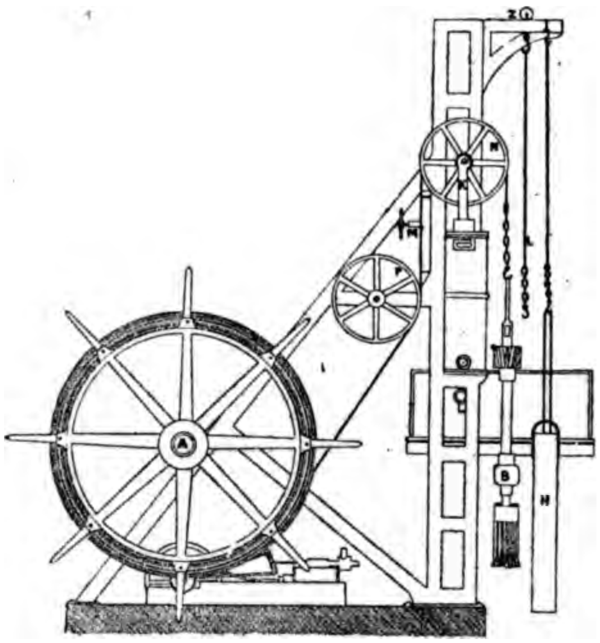

FIG. 1

ELEVATION OF MATHER & PLATT'S BORING MACHINE.

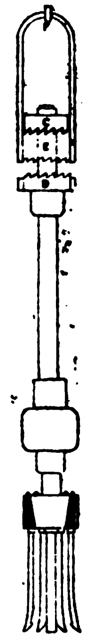

FIG. 2.

ENLARGED SECTION OF BORING TOOL.

REFERENCES:—

| | | | | |
|---|---|---|---|---|
| A Winding Drum | D Bottom Collar | H Shell Pump | M Clam | Z Roller |
| B Boring Machine | E Bush | K Fork | N Bearing Pulley | |
| C Top Collar | F Bow | L Suspension Bow | P Guide Pulley | |

fixed a pulley for the rope to pass over, and has flanges to keep it in its proper place. On the boring tool, just above the block, are two castings a little distance from each other. The bottom one acts as a guide to keep the bar perpendicular, and the topmost one has cast-iron plates secured to its circumference with ribs of a saw-toothed shape, arranged at such an angle that, as they bear against the side of the hole when the bar is raised or lowered, they assist it to turn as they will strike different portions of the rock at each stroke. Rotation is secured by two cast-iron collars which are cottered fast to a bar about twelve inches apart. On the top edge of the one and the lower edge of the other collar deep saw teeth are cut, two-inch pitch. Between these collars, and sliding on a bar, is a deep bush. To this bush is attached a wrought-iron bow by which the whole bar is suspended by means of a hook and shackle at the end of the flat rope. The boring head and piston fall by their own weight when steam is shut oft and the external valve opened, therefore the steam is applied at the bottom of the cylinder only. The exhaust port is about six inches from the bottom of the cylinder, and when the piston descends it rests on a cushion of steam which prevents any concussion. When a few feet has been bored the steam is shut off, the rope is unclamped, the winding engine put in motion, and the boring head brought up and slung from an overhead suspension bar by a hook fitted with a roller to traverse the bar. The shell pump is then lowered to extract the debris. The advantage of this system is the speed attainable in raising and lowering the tool and pump, and thus saving time which is lost in other systems.

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*Question* 9. (M.)—What are dry and wet air compressors? Which kind is preferable, and why?

*Answer.*—The chief or principal kinds of air compressors used in mining are the dry and wet compressors. (1) In a dry compressor the air enters the compressing cylinder by suitable valves, and is acted on direct by the compressing piston, and delivered into the air-mains or receiver. The air-valves in direct communication with the air-mains are opened, allowing the air to escape into the receiver; then the compressing cylinder fills again with air to be compressed on the back stroke, thus allowing a constant compression of air to be going on. (2) But in the case of wet-air compressors the compressing piston acts on a column of water, and this column of water is the direct agent in compressing the air. Great advantages have been claimed for wet compressors over dry ones, but the fact that they have not come into general use is sufficient evidence that they possess characteristics which so far render them unsuitable for mining purposes. These are the advantages or preference given to the adoption of wet compessors. (1) The column of water ensures an air-tight joint, thus preventing any escape of air in compressing. (2) It is claimed that the water abstracts a considerable amount of heat from the air, but on the other hand, the power required to overcome the inertia of the column of water is so considerable, and the compressor must work very slowly that it prevents the use of this kind of air compressor (wet) to any extent.

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Mapplewell, nr. Barnsley.

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*Question* 10. (M.)—What considerations would guide you in drilling holes for shots in a sinking pit bottom, and what are the arrangements you would make for firing?

*Answer.*—In drilling holes in a sinking pit bottom I should be guided by the strength and nature of the stratum in which the hole was to be drilled, the position and direction of any visible backs or slips, and the position of the line of least resistance. Sometimes in drilling a sump-hole in strong ground the hole itself is the line of least resistance, and when such is the case it requires to be heavily charged and very tightly tamped, or the result may be a blown-out shot. There are several different ways of drilling the holes such as percussive drilling, rotary drilling, and different systems of power drills which are worked by compressed air from the pit bank. Two familiar examples of this kind of drilling are *Beaumont's* and *Ingersoll's.* After having drilled the holes I should prepare the charge, which would probably be roburite. A hole is bored into the cartridge with a small wooden peg, and a detonator with an electric fuse attached inserted, and the mouth of the cartridge tied up. It is then pushed to the end of the hole with a wooden rammer, and the hole tamped lightly for a few inches with wet drill filings or dust, after which it is rammed solid to the mouth of the hole. A long cable is then connected to the fuse, and after the workmen have ascended to the shaft the shots are fired from the bank by means of an electric battery. It requires great judgment and care in deciding on the position the hole, and the amount of explosive for each hole, and none other than a thoroughly practical workman who has had plenty of experience should be placed in charge of this kind of work.

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## CORRESPONDENCE.

### The Lamp on the Belt.

Wigan,
December 4th, 1893.

*To the Editor of "Mining."*

Sir,

We find at many of the Collieries in this district that the workman is strictly prohibited from hanging his lamp on his belt. There are two words very familiar to the mining student, viz.:—"and why?" and I should like to affix them to the above statement. If a person is setting a prop his belt is a very convenient receptacle for his lamp. If he is nailing a brattice cloth he *instinctively* hangs his lamp on his belt, while he grasps the nail with one hand and the hammer with the other. This prohibition, I am aware, is not in force in the whole of our district. At some collieries the drawer may hang his lamp on his belt when going in or out with a tub, but when working at the face he is not allowed to have it on any portion of his clothing. Hoping your readers will give us their opinions.

I remain, yours truly,
"Firo."

*Printed and Published by* STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MIN

o 3. Vol. II. SATURDAY, DECEMBER 30, 1893. FORTNIGHTLY. ONE PENNY.


**CONTENTS.**



## EASY LESSONS ON MINE SURVEYING

**For Beginners.**

*Commenced in Number 2, Volume II.*

THE few, though by no means exhausted instances given in our last article of the advantages gained by a knowledge of surveying, will be sufficient to enable the student to understand that it is not as many ignorant miners think, a waste of time and money to make frequent and accurate surveys of the workings of a mine, etc.

The Geometrical definitions, theorems and problems, which will be given, should be learnt thoroughly by the student in this subject as they are constantly occuring, and without them the subject will be rendered difficult to understand, and although it may be possible to make a practical survey in a methodical manner without much more than a meagre knowledge of them, yet the subject cannot be understood, and the reasoning out of a survey will be quite a blank.

### DEFINITIONS.

A *Point* is that which denotes position or beginning of magnitude, but which has no magnitude, *i.e.* has neither length, breadth, or thickness.

A *Line* is length without breadth.

The extremities of a line are points.

A *Straight Line* is that which lies evenly between its extreme points, and is the shortest distance between any two points, as AB, Fig. 1.

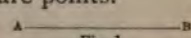


Fig. 1.

A *Plane Rectilineal Angle* is the inclination of two straight lines to one another, which meet together, but are not in the same straight line, as A, Fig. 2. When several angles are at one point, as A, Fig. 3, any one of them is expressed by three letters, of which the letter at the vertex or point where the lines meet is placed in the centre; thus the angle contained by the two lines BA, AC is expressed as the angle BAC or CAB, and that which is contained by the lines AC, AD is expressed as the angle CAD or DAC.

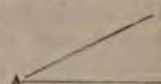


Fig. 2.

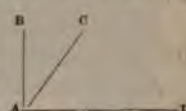


Fig. 3.

One angle is said to be less than another when the lines which form that angle are nearer to each other than those which form the other, measuring at equal distances from the points in which the lines meet. Thus in Figs. 4 and 5, A*a*, A*b*, D*c* and D*d* are equal to one another. But *ab* is less than *cd*. Therefore the angle BAC is less than

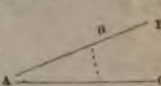


Fig. 4.

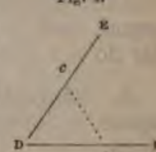


Fig. 5.

the angle EDF. The magnitude of the angle does not depend upon the length of the lines by which it is formed.

There are three kinds of angles, namely:—right, obtuse and acute.

A *Right Angle* is made by a straight line standing upon another straight line in such a position as to make the adjacent angles equal to one another. Thus in Fig. 6, the line AB stands upon the line CD, and makes the angle CBA equal to the angle ABD. The straight line AB is said to be *perpendicular*, and the straight line CD *horizontal.*

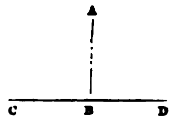


Fig. 6.

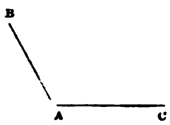


Fig. 7.

An *Obtuse* angle is greater than a right angle, as BAC, Fig. 7.

An *Acute* angle is less than a right angle, as BAC, Fig. 8.

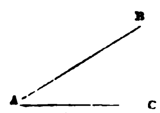


Fig. 8.

A *Plane* triangle is the space enclosed by three straight lines.

A *Right-angled* triangle is that which has one of its angles right angles, as ABC, Fig. 9. The side AC opposite the right angle is called the hypotenuse, the side AB is called the perpendicular, and the side BC is called the base.

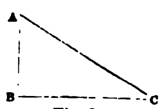


Fig. 9.

An *Obtuse-angled* triangle has one of its angles obtuse, as Fig. 10.

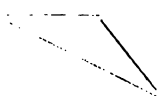


Fig. 10.

An *Acute-angled* triangle has all its three angles acute, as Fig. 11.

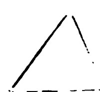


Fig. 11.

An *Equilateral* triangle has its three sides equal, and also its three angles, as Fig. 12.


Fig. 12.

An *Isosceles* triangle is that which has two of its sides equal, as Fig. 13.

A *Scalene* triangle has all its three sides unequal, as Fig. 9.


Fig. 13.

*Parallel* lines are such that the distance between them is always equal, and if produced ever so far do not meet, as Fig. 14.


Fig. 14.

A *Quadrilateral* figure is a space included by four straight lines.

A *Parallelogram* has its opposite sides parallel and equal, as Fig. 15.


Fig. 15.

A *Rectangle* is a parallelogram with all its angles right angles as Fig. 16.

A *Square* is a rectangle with all its sides equal, as Fig. 17.


Fig. 16.

A *Diagonal* of a quadrilateral is a straight line joining two opposite angles, as Fig. 18.

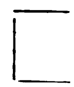


Fig. 17.

*Polygons* or *Multilateral* figures are those which have more than four sides. If it has five sides it is called a *pentagon*, if six sides a *hexagon*, if eight sides an *octogon*, and so on. A regular polygon is one which has all its sides equal, and its angles equal.

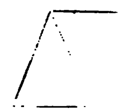


Fig. 18.

A *Circle* is a plane figure contained or bounded by one line which is called the circumference, and is such that all straight lines from a certain point within the figure to the circumference are equal to one another. This point is called the centre of the circle, as Fig. 19, O being the centre.

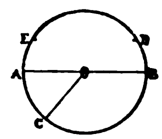


Fig. 19.


Fig. 20.

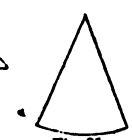


Fig. 21.

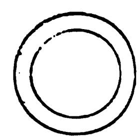


Fig. 22.

The *Radius* of a circle is a straight line drawn from the centre to the circumference, as C, Fig. 19.

The *Diameter* of a circle is a straight line drawn through the centre, and terminated both ways by the circumference, as AB, Fig. 19.

An *Arc* of a circle is any part of the circumference as ED, Fig 19.

A *Chord* of a circle is the straight line which joins the ends of an arc.

A *Segment* of a circle is the figure bounded by a chord and the arc it cuts off, as Fig. 20.

A *Sector* of a circle is the figure bounded by two radii, and the arc between them, as Fig. 21.

*Concentric* Circles are those having the same centre, and the space included between their circumference is called a ring, as Fig. 22.

*(To be continued.)*

# HAULAGE.

## Chapter IV.

Self-acting Inclines.—(Contd.)

On incline planes it often happens that several levels extend on either side throughout the course of the plane, and special arrangements must be made for the exchange of double sets of rails are laid throughout the plane. The length of the main rope or chain is the same as required for ordinary purposes on self-acting inclines, viz. :—to effect an exchange of tubs between the two ends of the incline. It is shown in the sketch attached to the full tub A, from whence it extends round the wheel to the empty tub D, at the bottom of the incline.

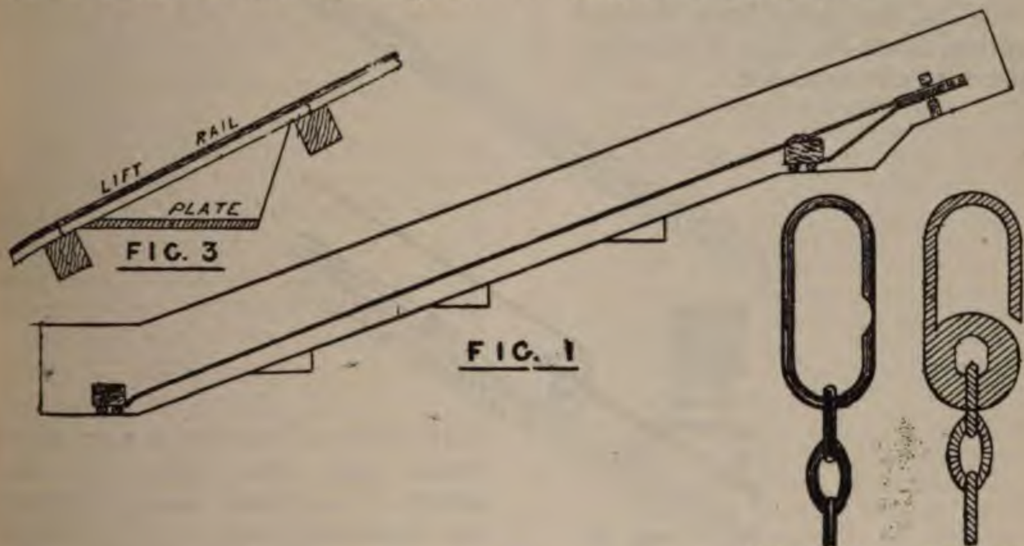



FIG. 3

FIG. 1

FIG. 4

FIG. 5

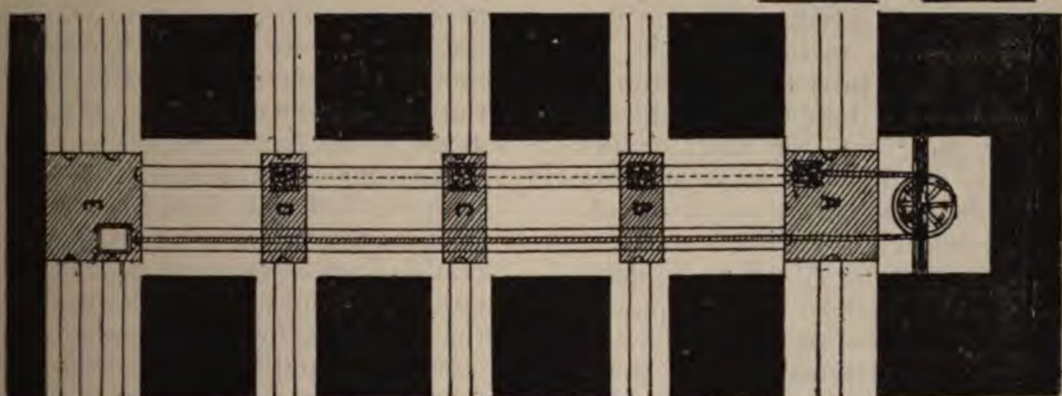


FIG. 2

tubs at these points. This is done by a method known as the "cut-chain" system. In this system, which is illustrated by Figs. 1 and 2,

The levels are at equal distances apart, and the arrangement for effecting the exchange of tubs at the intermediate levels is clearly shewn

in the enlarged section (Fig. 3). The position of the rails of the incline is shewn by the left rail, and the rails at this point are fitted in such a manner that they can be easily lifted to one side to allow the tubs to be pushed from the level on to the landing-plate which is placed horizontally below the rails, and the same height as the rails in the level. The tubs are next transferred from the landing-plate to the rails on the down-brow side of the incline, when the rope is attached and the lift rails replaced.

tub has been drawn up to the level B. In the same manner, if it be desired to run tubs from the point C, another cut-chain is attached to the first, and if from the level below, viz. :—D, still another is added, and the tubs are let down as in the first instance.

This system of haulage cannot be worked with advantage if the inclination is less than 1 in 6, and even then the distance upon which it can work seldom exceeds one hundred yards.

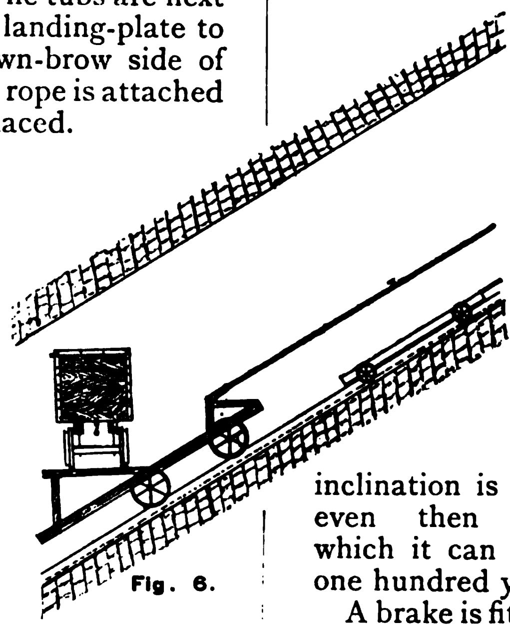


Fig. 6.

We will now briefly describe the working of the incline. If it be desired to run tubs from the top of the incline it is done in the ordinary manner, the "cut" or short chains necessary for the other arrangements being left in the centre of the road. We will next consider the manner of running tubs from B. This is done by means of a short chain, equal in length to the distance between the levels, being fastened to the main chain at the point A by means of a link and H-hook shown in Figs. 4 and 5; the other end of the short chain is then fastened to the full tub. The full tub is then let down and on its arrival at the bottom the empty

A brake is fitted to the pulley wheel at the top of the incline, and by means of a wire which is fixed in the incline, and fastened to the handle, the speed of the tubs can be regulated at any point in the plane.

Another arrangement for the "jigging" of tubs from intermediate levels is the balance. In this system double lines of rails are required, but one gauge may be made narrower than the ordinary gauge of the colliery as only one tub called the "balance box" runs upon it. The arrangement will be easily understood when it is stated that only one gauge is used for both full and empty tubs, and two runs are thus necessary for the exchange. We will suppose

the balance box, which is a long narrow tub weighted usually with stones so that it is heavier than an empty tub but lighter than a full one, to be at the bottom of the brow. A full tub is attached to the rope at the top, and let down. This pulls up the balance box to top. The full tub is detached from the rope at the bottom and an empty one attached. The balance box is then let down and the empty one is pulled up. In this manner tubs may be sent from any part of the brow, and the empty tub is arrested on its ascent at the level where required.

A curious arrangement of balance brows peculiar to the steep mines of the Continent is shown in Fig. 6. The inclination is such that it is altogether impractible to run the tubs down in the ordinary as the coals would fall out. To overcome this a tram is made as shown in figure, and upon this both the full and empty tubs are conveyed. The balance consists of a long narrow heavy tram and is made low enough to pass *under* the carriage for the tubs at the junction, and is run upon a narrow gauge placed inside the gauge for the carriage. To facilitate the passage at the junction the narrow gauge is slightly depressed as shewn. In this case, as in the other balance arrangement, the counter-balance must be heavier than the carriage and the empty tub, and lighter than the carriage and the full tub.

The inclination of balance-brows must be far greater than the inclination of ordinary self-acting inclines as it has to be such that it will allow the full tub to raise the balance, which is heavier than the empty tub, and this in turn must raise the empty tub.

*(To be continued.)*

# ACCIDENTS IN MINES & THEIR PREVENTION.

EXTRACT FROM COMMISSIONERS' REPORT.

### Fall of Roof and Sides.

THAT the casualties due to the falls of the roof and sides are much more numerous than those due to any other cause, is demonstrated by the tabular statement given. It is essential that all the officials and workmen in mines should pay special attention to the careful propping of the working places and travelling roads.

In the North of England the system of trusting mainly to officials (deputies) for the timbering is found to answer well. In South Wales and other districts where the roof, face and sides are more liable to falls, the system of the men timbering their own working places has been found to be best.

We are of opinion, however, that in all cases the security of the working places should be examined into by overlookers once at least in the course of each shift. Supervision has been greatly enlarged in the last thirty-five years and we find that there is generally one official so employed to about twenty men, sometimes one even to eleven or twelve men.

In order to reduce the number of casualties from falls, we recommend the observance of the following:—(*a*) The maintenance of ample supplies of timber in localities convenient to the workmen. (*b*) The proper training of each miner to the best modes of timbering, and of otherwise protecting his working place. (*c*) The exercise of increased care on the part of the workmen in watching the roof, sides and face, and protecting themselves in time. (*d*) The introduction, as far as possible, of arrangements with the workmen, which will make it their interest not to avoid the labour of putting up the necessary timber, cog walls, buildings, or cogs, for their proper protection. (*e*) The employment of special timbermen or deputies for the timbering of main ways, and also for the repairing as well as drawing of timber. (*f*) Preventing timber being left in the goaf of longwall workings, which would have the effect of breaking the roof. (*g*) Driving the working places as rapidly as possible by shifts of an ample number of workmen in each face, and so reducing the risk of falls, and exposing the least number of men to danger at one time.

## GLOSSARY OF MINING TERMS

### (NORTHUMBERLAND)

*Continued from last Number.*

**Limber-bolt**—A bolt for connecting the limbers to the tub.

**Loose-end**—That end of a working place which has been passed by another place forming a face at right angles to the regular working face.

**Lowze**—The end of a shift or day's work.

**Main-gateway**—Usually the centre gateway of a district or flat used for the main haulage road.

**Main-rope**—The rope that hauls the full tubs out-bye, in the main and tail-rope system of haulage.

**Manager**—The person who exercises daily personal supervision in the mine, and is responsible for the management and direction of the mine.

**Marrow**—Working partner.

**Match**—A piece of greased cotton rag for firing a straw fuse for a charge of gunpowder.

**Mell**—A hammer for breaking coal, stone, or wedging.

**Metal-tubbing**—A cast-iron cylinder made up of segments in a shaft for keeping back water, &c.

**Narrow-bord**—A narrow place driven in the direction, and usually in advance of the general workings.

**Nicking**—The art of cutting the side of a working place to form a loose end.

**Night-shift**—The shift or set of men who work at night.

**Nip-out**—A fault that cuts out the coal seam.

**Nuts**—The coal that is left on the screen the second time of screening.

**Onsetter**—The person who changes the tubs in the cage at the shaft bottom.

**Opening**—The coal that comes off after a working place holes into another, is called opening.

**Outcrop**—When the coal seam comes out to the surface.

**Owners**—The proprietors of a colliery.

**Pack-wall**—The stone that is stowed in the goaf of the longwall working to support the roof.

**Pair-of-gears**—A plank placed against the roof, supported at each end by a prop.

**Pay-Friday**—The day on which the miners are paid.

**Pick**—A pointed tool for holing and nicking coal.

**Pillar-of-coal**—An oblong or square block of coal to support the roof.

**Pinch**—A bar of round iron with a chisel end for forcing down stone, &c., sometimes called a crowbar.

**Pins**—Pieces of wood, pin-shaped, for fastening metal chairs to wood sleepers.

**Pit-eye**—The bottom of a shaft.

**Pit-man**—A common name for a miner.

**Plank**—A bar of wood for setting on props to support the roof.

**Plate**—A short iron rail used on the barrow way.

**Plate-ends**—The ends of the barrow way in the workings.

**Plunger**—A piston for forcing water up a forcing set of pumps.

**Point-turn**—Cast-iron metals for commencing a road off another road.

**Pricker**—A needle-shaped piece of copper four feet long, for fixing into a shot of gunpowder when the hole is being filled or stemmed.

**Pump**—(Forcing set) The water being forced to the surface or launder by the downward stroke of the engine.

**Pump**—(Lifting set) The water is lifted on the upward stroke of the engine.

**Punch-props**—Props that are set between wood cribs to support them.

**Putter, Hurrier, Barrowman**—The person who hauls the coals from the working face to the flat.

**Rank-money**—The price per score of tubs the putters claim for every thirty yards or so after a given distance.

**Rapper**—A contrivance for giving signals in a winding shaft.

**Recking-day**—A day for recking with the overman about the takings on pay-day.

(*To be continued.*)

## EXAMINATION QUESTIONS,

With Answers, by

THOS. FLETCHER, First-Class Certificated Manager

The following questions for the examination of Candidates for Certificates of Competency were set in the Manchester District, 1890.

### FIRST-CLASS CERTIFICATES OF COMPETENCY.

*(Continued from last issue.)*

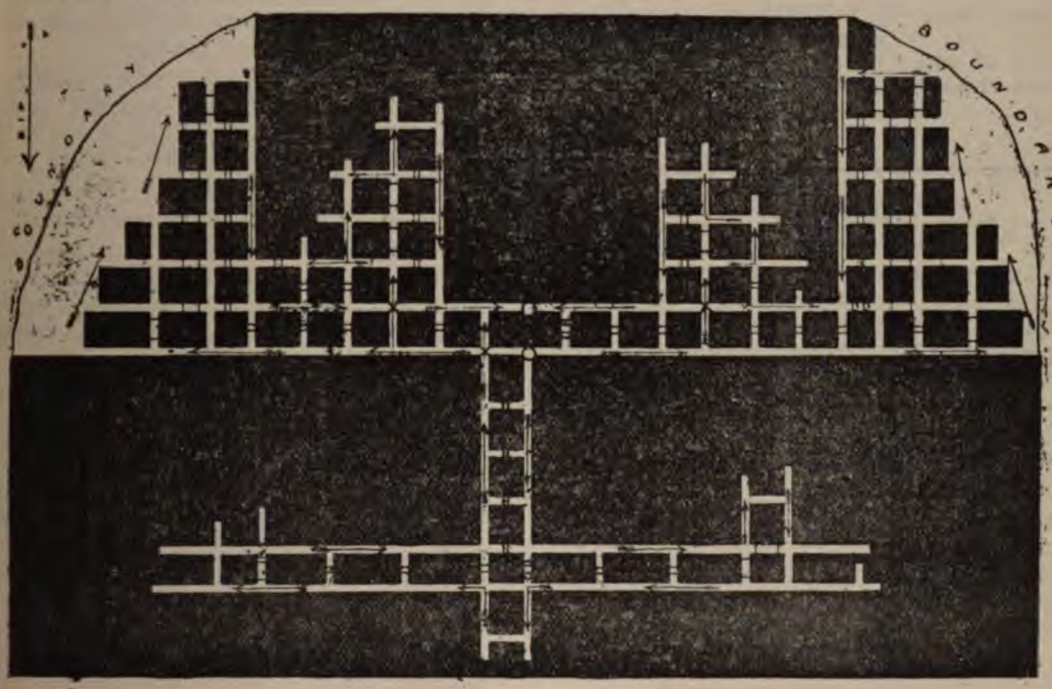
### Cas and Ventilation.

QUESTION 19.—What are the two deleterious gases most commonly met with in coal-mining—their chief properties, the special danger from each, in what places are they most likely to be found, and how is their presence detected ?

ANSWER.—The two most deleterious gases met with in coal-mining are black-damp ($CO_2$) and fire-damp ($CH^4$). Black-damp is colourless and odourless, but has a slightly acid taste. It is a very heavy gas having a specific gravity of 1·528, and is, in consequence, found in dip workings, sumps, wells, etc., and may be known by not allowing a light to burn, or at least causes it to become dim. It will not support life, and has a poisonous effect when taken into the system. Fire-damp is a very light gas, specific gravity ·555, is colourless and inodorous, and is found in cavities in the roof and in rise workings. When mingled with air in sufficient quantities it becomes explosive, and is most violent when one part of fire-damp is mixed with about eight parts of air; but if a still greater quantity of gas is added, say one part to three parts of air, it will not explode but will cause suffocation. It may be known from the appearance which the flame of a lamp presents when burning in it.

QUESTION 20.—How would you ventilate the workings shown on the annexed plan ?

ANSWER.—See plan.



REFERENCES:—

Up-cast Fan Pit. Downcast Winding Pit.

Direction of current shewn by arrows.

D D Doors. X Crossings. II Stoppings. I I Cloth Sheets.

No regulators are required as the course of each split is about the same.

QUESTION 21.—Describe any mechanical ventilating machine with which you are acquainted. Explain its principles of action, and state its advantages and disadvantages compared with a furnace.

ANSWER.—The fan which I prefer, and am best acquainted with, is the *Waddle*. At about five hundred yards deep, under ordinary circumstances the fan and furnace are about equal in efficiency. In deep dry shafts furnaces are more efficient, and in wet and shallow mines the fan. The numerous advantages which the fan possesses over the furnace, however, warrant its use under almost all circumstances.

(For illustrations and description of this fan see No. I., Vol. II.—Editor.)

QUESTION 22.—What is the theoretical velocity in feet per minute of the current of air which would be produced by a pressure equal to 1 inch of water-guage, barometer reading 29 inches, and temperature 32 Fahr.

ANSWER.—To find weight of air:—

*Atkinson's* Rule, $\frac{29 \times 1{\cdot}3253}{459 \times 32} = {\cdot}07827 =$ weight of air. $5{\cdot}2$ w.g. $\div$ $07827 = 66$ motive column. $\sqrt{66} = 8{\cdot}124 \times 8{\cdot}02 =$ $65{\cdot}15448$ velocity.

## NOTICES.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Literary communications to be addressed to the Editor, "Mining," Clarence Printing Works, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

## PRIZE COMPETITION.

### QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by January 6th, 1894.

*Question* 1. (E.)—What are the essential points in the construction of the *Davy* Lamp, and with what velocity of air does it become insecure? Give sketch.

*Question* 2. (E.)—Give examples of the use of wedging in breaking coal and rock, and show how far it is possible to substitute it for blasting with gunpowder.

*Question* 3. (E.)—Describe briefly the main-and-tail rope system of haulage.

*Question* 4. (A.)—A block of coal is 1 acre, 2 roods, 10 perches (Statute measure) in area, and is four feet three inches in thickness, What weight of coal is there in the block, reckoning 18 cwt. per cubic yard?

*Question* 5. (A.)—Draw and describe a permanent regulating door.

*Question* 6. (A.)—What course would you try when the roof of a roadway is very destructive of timber, and almost impossible to support?

*Question* 7. (H.)—Give a tabulated summary of the coalfields of the British Isles.

P.S.—The award for this question will be increased to 2s. 6d.

*Question* 8. (H.)—Give a surface plan shewing offices, boilers, engine houses, etc., of an independent colliery.

*Question* 9. (M.)—Give a description of the manner in which you would ventilate a mine, giving reasons for the fixing of various arrangements to accomplish same, and their position, etc.

*Question* 10. (M.)—If, whilst making a survey, you lost the angling screw immediately after taking a true bearing with the needle, and it was not possible to remove the iron in the remaining part of the survey, how would you proceed?

## ANSWERS TO QUESTIONS

**In No. 1, Vol. 2.**

*Question* 1. (E.)—State the objections to the plan, which has been sometimes suggested, of ventilating the goafs of collieries by bore-holes from the surface?

*Answer.*—The objection to this suggestion is the bore-holes would have to be of large size to allow any considerable quantity of gas to escape, the velocity being so great, and a shaft could be sunk as cheaply as several boreholes.

SUB-EDITOR.

*Question* 2. (E.)—What are the circumstances under which gunpowder for blasting may be put in loose, or should be in cartridges? Compare the two methods.

*Answer.*—The advantage of using loose powder is that the charge can be regulated to a nicety, but the danger of the loose powder falling from the can and lying about the floor, is such that the best method is to use cartridges only. The loose powder may act as a train to fire a shot before the men get safely away.

SUB-EDITOR.

*Question* 3. (E.)—What measures may be taken, without introducing machinery, exciting a ventilating current, to improve the air in a particular district in a mine?

*Answer.*—In some cases it is necessary to force air into the in-bye districts, and for this purpose regulators are erected. The regulator consists of a square or rectangular frame which is morticed together, and fitted with slots top and bottom in which a door is placed to slide backward or foward as required. After having decided upon the quantity of air required, experiments are made with the anemometer, and the area of the regulator is increased or decreased until the required amount of air passes through. The regulator must be kept constantly at the same area, and it is therefore securely locked by means of a chain and lock. The regulator is fixed on the return side of the of the workings. The use of regulators in mines should be limited to unavoidable cases as they set up an artificial resistance in the path of the air currents, thus reducing the total amount of air circulating in the mine. This method will increase the quantity of air in any particular district, but only at a loss to other districts. Another method would be to fix a water trompe with its exit pipe at the district required, but this would only be possible for shallow shafts, and the district would require to be at a short distance from the shaft.

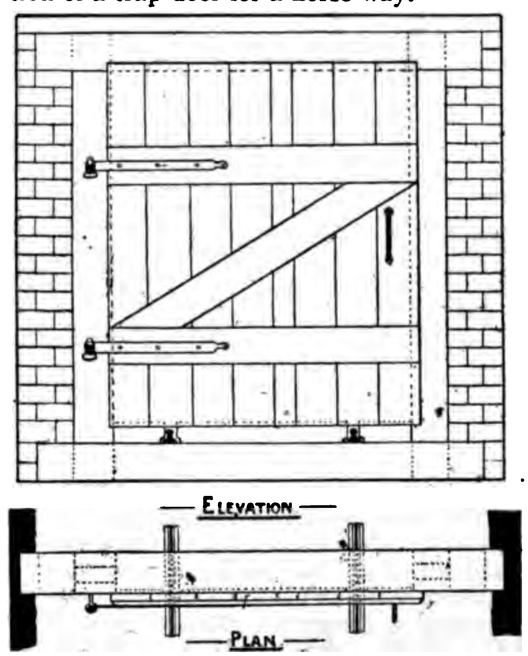
WILLIAM P. LAWS,
25, Pilgrim Street,
Murton Colliery, Co. Durham.

*Question* 4. (A.)—What is a steam engine, and what is the principle of its action?

*Answer.*—A steam engine is a machine for converting the heat imparted to steam by the combustion of coal, &c., into mechanical work. The principle of action of the steam engine is based upon the first law of Thermo-dynamics, which reads as follows:—Heat and work are mutually convertible into each other, and this is accomplished by burning coal in or under a steam boiler. The heat passes through the plates of the boiler by conduction, and then the water is heated by convection. Steam is thus generated to a convenient safe working pressure, and conducting the same to act on the piston in the cylinder power is then conducted from the piston, through the piston-rod, to the connecting-rod, thence to the crank and crank-shaft on which drums, pulleys, or gearing are placed for winding, hauling,. &c.; in fact for any purpose whatever.

THOS. BANKS,
7, Church Street,
Haydock, Lanc.

*Question* 5. (A.)—Sketch neatly in ink, to a scale of one inch to a foot, a plan and elevation of a trap-door for a horse-way.



*Answer.*—The accompanying sketch shows a trap-door in plan and elevation. These doors vary in height between four and six-and-a-half feet, and are generally put between uprights (inside of frame).

(The sketch has been reduced from the original.)

JNO. LAVERICK,
Eppleton Colliery,
Hetton-le-Hole, R.S.O.

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*Question* 6. (A.)—What diameter must a circular pit be to have the same area as an oblong one, which is nineteen feet by six-and-a-half feet.

*Answer.*—The rule to find the area of a circular shaft is diameter$^2$ × ·7854.

Therefore, 19 feet × 6½ feet = 123½ feet, area of oblong shaft; 123½ feet × ·7854 = 157·25 nearly, then the square root of 157·25 = nearly 12·5 or 12½ feet.

ANSWER.—12½ feet diameter of circular shaft

RICHARD GORTON JUNR.
26, Lancaster Street,
Murton Colliery,
*via* Sunderland.

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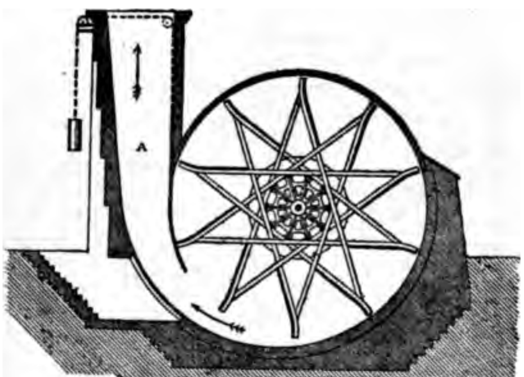
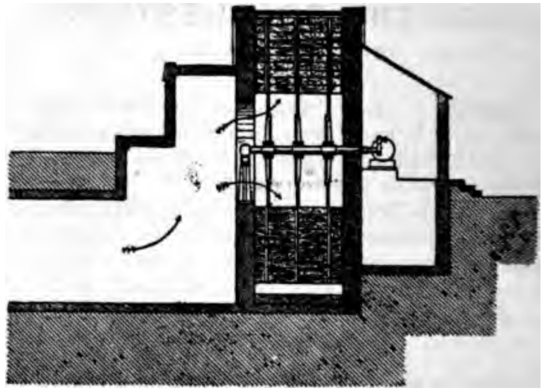
*Question* 7. (H.)—Describe with sketch the *Guibal* Fan, and discuss its effectiveness.




*Answer.*—The most important part of this fan is a large revolving wheel which has arms or blades projecting from the centre, each blade being curved at the extremity. This structure is enclosed by a covering of iron. The air enters the fan by a drift from the up-cast shaft, and as each blade passes this opening it grasps a certain amount of air. Nature now steps in, and because it abhors



a vacuum the air which each blade takes away is replaced by more air, and thus ventilation is produced. The air leaves the fan by a chimney which is larger at the top than at the bottom so as to lessen the resistance which the exhausted air meets with the atmospbere. The quantity of exhausted air discharged can be regulated by a sliding shutter. The fan is generally driven by a horizontal steam engine, but two engines are frequently kept in case of accident to the working engine. The *Guibal* Fan is most generally used, and it is known to be one of the best fans used in colliery work, and for durability and little expense in working it has given universal satisfaction.

W. D. HARBIT,
32, High Street,
Wallsend-on-Tyne.

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*Question* 8. (H.)—In sinking with a rock drill describe all the arrangements you would make for applying it to its work, and what precautions you would take for its protection while blasting. Give your opinion under what circumstances it becomes most serviceable, and whether it forms an efficient tool in facilitating sinking operations.

*Answer.*—In sinking with a rock drill it is applied to its work by securing the piston to a horizontal bar, which is firmly clamped to the sides of the shaft. The horizontal bar carrying the machine can be raised up the shaft, by means of a rope or chain, when blasting has to be done. The *Darlington* Rock Drill is a very good medium for sinking operations. It has no valves: the foward and backward strokes of the piston are effected by a difference in the area of the annular surface at the front of the piston and the area of surface at the back.

It is worked by compressed air, the compressed air pipes being carried down the shaft, and the connection made with the machine by means of a flexible hose. The drill advances automatically, and is turned by a rack and screw of coarse pitch. It makes about 200 strokes per minute. It is very efficient, and has recommended itself for use in sinking pits.

ALBERT HART,
173, Kiveton Park,
near Sheffield.

*Question* 9. (M.)—A ventilating fan running at forty-five revolutions per minute produces a water-gauge of 1·75 inches. What will the water-gauge be if the fan speed is increased to sixty revolutions per minute?

*Answer.*—The Water Gauge registers the ventilating pressure per square foot, and also the amount of resistance or drag. According to Atkinson, *the resistance increases as the square of the velocity.* The velocity will be in the ratio of the speed of the fan.

$$\frac{1\cdot75 \times 60^2}{45^2} = \text{water gauge} = \frac{1\cdot75 \times 3600}{2025} =$$

3·1 inches Water Gauge.

WILLIAM LITTLER,
234, Woodhouse Lane,
Wigan.

*Question* 10. (M.)—What is meant by good discipline in a colliery, and what efforts would you make to maintain it?

*Answer.*—Good discipline in a colliery means that every person in and about the mine should know his particular duty or duties, and should perform those duties satisfactorily. In order that this state of things may be accomplished, the greatest possible strictness and straightforwardness is necessary. The fireman should have a particular district for the safe working of which he is responsible. His duties should be posted up in the office (underground), in addition to being instructed in those duties by the under-manager. Every miner should be carefully warned as to the greatest distance between his props and sprags, where required, by notices posted either at the pit-head or underground. Every official should know for what things he is responsible, and should meddle with none but his own particulars duties. Every workman should know as soon as he commences employment such things as are not allowed in the mine, as the position of his lamp, etc., and should also be told the penalty of any breach of the bye-laws in force in the mine, and such penalties should be strictly inflicted, as an example to others. All of these rules should be posted so as to be seen by all the workmen. A copy of the "Act" should be presented to every workman. The officials should speak civilly to their workmen and give them every information respecting their work. If these things were attended to there would be less grumbling about the workings of the mine by the workmen because of their not knowing properly what they have to do; there would be fewer fines, which are so objectionable to masters and men; and there would be fewer accidents, as the men would attend more carefully to the propping and securing of their places if strictness was the rule.

WILLIAM LITTLER,
234, Woodhouse Lane,
Wigan.



## ANSWERS TO CORRESPONDENTS.

S. Bartley.—You may get what you require from Messrs, Thos. Wall & Sons, Wigan. We think the price is about Threepence. You are correct as to the meaning of the terms.

Contributor, and Others.—All back numbers of this paper can be had at this Office.

# CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.

Envelopes to be marked "Correspondence."

Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

## THE COLLIERY FIREMAN.

Barnsley.

*To the Editor of "Mining."*

Dear Sir,

With reference to the above which I find discussed in the columns of your Journal I am of the opinion that it is impossible for a person to lawfully discharge the duties of a fireman without being able to write. I am pleased to see that your correspondent "Firo" is in favour of a clause being inserted in the C.M.R.A. requiring a person to pass an examination and obtain a certificate of competency before acting as a fireman. I do not mean the examinations to be of such a nature that it will require a good education to be able to pass, but should consist of questions relative to the C.M.R.A., gases, etc., and be such that a good practical miner with an elementary education should be able to obtain a certificate. Even under this arrangement many good practical men will be exempted as their chance of scholarship was much less than at the present time, but this defect will, I think, be more than equalised by the good which it would undoubtedly, do by preventing incompetent persons from obtaining a situation as firemen. All that is wanted is to make the questions practical enough, and better still, make it compulsory for a person to work in one or more of the different grades of coal-getting, fireman, and under-manager before he can occupy a position in any subsequent grade.

Yours truly,

"Fireman."

*To the Editor of "Mining."*

Sir,

On perusing your last issue I observe that your correspondent "Firo" doubts the truth of the statement that persons are employed as firemen or deputies who can neither read nor write, and he fails to understand how they can discharge the duties devolving upon them. Allow me through your Journal to inform him that there are collieries in the County of Durham where the deputies keep their report books at home, only taking them to the office to be signed by the manager. There are other collieries where the report books are kept in the weigh office, on the door of which is painted in large letters:—"No admittance except on business. By Order. R—— T—— Manager." I will leave "Firo" to form his own conclusions as to how the reports are made out. C.M.R.A., General Rule 4, requires that such report be in the handwriting and signed by the person who made the inspection, and every such report shall be accessible to the workmen, and yet, Sir, these very men who practise this sort of thing daily will not scruple to punish a workman if he violate one jot or title of the C.M.R.A.

Yours,

"Incedo.'

Westhoughton,

December 8th, 1893.

*To the Editor of "Mining."*

Sir,

Allow me to say a few words with respect to the difficulty experienced in obtaining "Mining" in this district. As you know, I am a competitor in your Prize Questions Competition, and not having much spare time at my disposal, and sometimes not being able to get my copy of "Mining" till late in the week in which the Competition closes, I am at a disadvantage in getting the answers ready. I ordered it from one newsagent, but he only got me one copy, and he says they have not sent it since. Hoping the newsagents will see the wisdom of obtaining a supply of your excellent paper.

I am,

Yours respectfully,

"MINING STUDENT."

*Printed* and Published by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.


No 4. Vol. II. SATURDAY, JANUARY 13, 1894. **FORTNIGHTLY.** ONE PENNY.

**CONTENTS.**



# EASY LESSONS ON MINE SURVEYING
## For BEGINNERS.

*Commenced in Number 2, Volume II.*

### GEOMETRY.—(Contd.)

THIS series of articles are not intended to be an elaborate and exhaustive treatise on Surveying, and in consequence, many problems, etc., usually found in geometry books will be omitted as unnecessary.

The following Theorems, which it will be advantageous to remember, are shown to be true in Euclid's Geometry, but it is sufficient for our purpose to know that this is so, as the proof is of no practical use.

### THEOREMS.

I. Let the straight line AB, Fig. 23, make with the straight line CD on one side of it, the angles ABC and ABD; these angles will be together equal to two right angles.

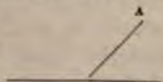


Fig. 23.

II. The angles of every triangle are together equal to two right angles.

III. If two sides of a triangle are equal, the sides opposite to them will also be equal. If two angles of a triangle are equal, the sides opposite them will also be equal.

IV. If two sides of one triangle are equal to two sides of another triangle, each to each, and the angle contained by the two sides of the one equal to the angle contained by the two sides of the other, the triangles will be equal in every respect.

V. If two angles of one triangle are equal to two angles of another triangle, each to each, and either the side adjacent or opposite to the two angles of the one equal to the side adjacent or opposite to the two angles of the other, the triangles will be equal in every respect.

VI. If the three sides of one triangle be equal to the three sides of another triangle, and be placed in the same order, the triangles are equal in every respect.

(The system of surface surveying by means of triangles is based upon this.)

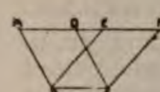


Fig. 24.

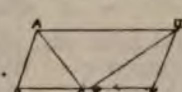


Fig. 25.

Fig. 26.

VII. Any two sides of a triangle are together greater than the third side.

VIII. Parallelograms upon the same base, or upon equal bases, and between the same parallels, are equal to one another. Let ABCD, Fig. 24, and EBCF be two parallelograms. Then ABCD is equal in area to EBCF.

IX. Triangles upon the same base, or upon equal bases, and between the same parallels are equal to one another. Thus the triangle ABC, Fig. 25, is equal in area to the triangle DEF.

X. A triangle is equivalent to half a parallelogram, having the same base and height. Thus the triangle ABC, Fig. 26, is half the parallelogram DBCE.

XI. In any right-angled triangle the square described on the hypothenuse is equal to the sum of the squares described on the sides.

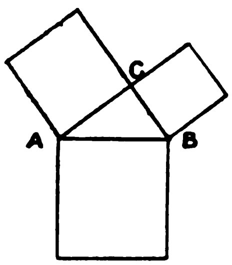


Fig. 27.

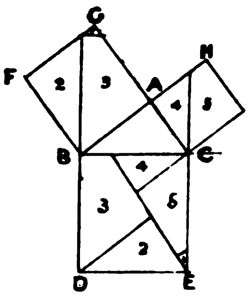


Fig. 28.

In Fig. 27, let the angle ABC be a right angle; then the square upon AB is equal to the sum of the squares upon AC and BC.

From this proposition is deducted a very useful and practical mode of drawing a perpendicular to a given line, from any point in the same. Let AC, Fig 27, be the given line, and C the given point in it. Now, with a scale of equal parts—for purposes of illustration we will take a $\frac{1}{8}$th—measure off four parts along CA. Thus, in our case, CA will equal $\frac{4}{8}$ths. Now, with a compass make an arc of a circle whose centre in C, and whose radius is $\frac{5}{8}$ths. Then the line joining C and the point of intersection is perpendicular to AC. That is, BC is perpendicular to AC. This may be proved by the problem—

$$AB^2 = AC^2 + CB^2$$
$$\therefore \left(\tfrac{5}{8}\right)^2 = \left(\tfrac{4}{8}\right)^2 + \left(\tfrac{3}{8}\right)^2 \text{ or}$$
$$25 = 16 + 9 \text{ which is evident.}$$

Thus we could take 5ft., 4ft. and 3ft., to construct our right-angled triangle instead of $\frac{1}{8}$th of an inch, and this is in fact what is done by builders, etc., when it is required to make anything square or square off, such as the corner of a building.

Fig. 28 gives a very interesting ocular demonstration of the truth of this very important proposition. The squares described on the sides of the triangle are divided by straight lines into figures, such that those contained by the two squares of the sides adjacent to the right angle are equal to those contained by the square on the hypotenuse. The areas denoted by the same figures are equal.

We will now give the solutions of *a few problems which* occur in practice. In geometry, only a ruler and compass are employed, but other instruments are used in practice such as a square and parallel rulers by means of which the figures can be drawn with greater facility. We will therefore not consider any of these. but simply explain the action of the instrument used instead. The student should draw the figures for himself upon suitable paper fixed to a drawing board, by means of pins. They should be first drawn in pencil, using a very hard pencil (H H H), and afterwards inked in neatly with Indian ink, the straight lines being done by means of a drawing pen, Fig. 30. The point of a pencil is not sufficiently sharp to mark measurements with, as in some cases the scale upon which the plans are drawn is such, that the width of the pencil mark would mean a distance of several yards. It thus becomes necessary to employ some more suitable means of fixing a position on the drawing paper than by means of the pencil. This is accomplished by using a fine needle, which may be clamped into a suitable holder, as Fig. 29, or may be made convenient for using by inserting the blunt end into an ordinary pencil. This is done by breaking off the top part of the needle, and next, by means of a pair of tweezers, forcing the broken end into the pencil leaving about $\frac{3}{8}$ths of an inch of the point of the needle extending.


Fig. 29

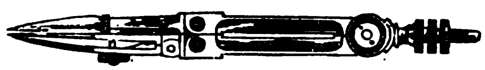

Fig. 30.

## PROBLEMS.

I. To describe a circle with a given radius about a given point as a centre. Let AB, Fig. 31, be the given radius. Place one point of the compasses, Figs. 32 and 33, on A, and extend the other point to B; then, with that distance as a radius, describe a circle by placing one point of the compasses at the given centre, and describe a circle with the other point. This will be the circle required.

Fig. 31.

Fig. 32.



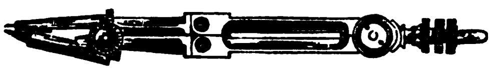


Fig. 33.

II. To bisect a given straight line, that is, divide it into two equal parts. This is usually done in practice by applying a scale of equal parts to the line. The number which it measures is divided by two, and the scale is again applied to the line, and this distance is measured off and marked by the pricker. (Sometimes the hole made by the pricker is so small as to give some difficulty in finding, if needed again. A small ring should therefore be made by means of the pencil round the hole, and it will thus be easily found.)

III. To draw a straight line parallel to a given straight line AB, Fig. 34. This is usually done by means of a parallel ruler, Fig. 36, which consists of an ordinary ruler with rollers attached to the centre. To draw a line parallel to AB fix the ruler with its edge exactly over and in line with AB. Then draw it down to the required distance by pressing gently on the centre, and draw a line. This line will be parallel to AB.

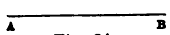


Fig. 34.

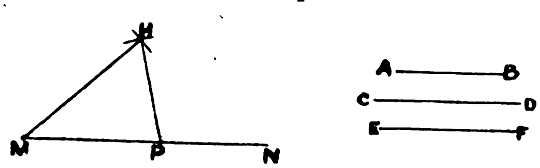


Fig. 35.

IV. To describe a triangle whose three sides shall be respectively equal to three given lines, any two of which must be greater than the third. Let AB, CD, and EF, Fig. 35, be the three given lines. Draw any line MN, and from it cut off a part MP equal to AB; then from M as a centre, with CD as a radius, describe an arc at H; and from P as a centre, with EF as a radius, describe another arc cutting the former in H, and draw MH and PH. Then MPH is the required triangle.

V. To draw lines at right angles to a given straight line from a given point in or without it. When the paper upon which this is required to be done is attached to a drawing board lines can be drawn at right angles by means of the T-square (Fig. 37). The head or cross part of the square being placed against the side of the drawing board. But, if the paper is upon an ordinary table, lines may be drawn at right angles to a given line


Fig. 3

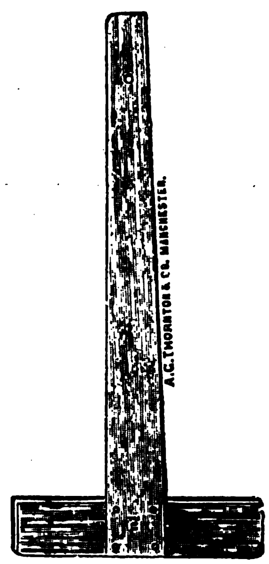


Fig. 37.

by means of a set square. A set square consists of some suitable material, as ebony or composition, cut so that two of its sides form a right angle. The other angles may be each 45°, or one 60° and the other 30°. Then, by placing one side of the set square exactly over and in the same direction as the given line, a line may be drawn along the other side of the square. This line will be at right angles to the given line.

(*To be continued.*)

# HAULAGE.

## Chapter V.

### Self-acting Inclines—Continued.

THAT modification of self-acting inclines, known as balance brows, is greatly varied in arrangement at different localities. Thus instead of allowing the balance box to run down the full length of the road it is only allowed to go, say half way. To accomplish this it is necessary to have two separate drums working upon the same axle; that upon which the balance rope winds is of less diameter than the drum for the load, in order that the drums will have the same number of revolutions. Another method adopted is to allow the counterbalance consisting of a suitable weight to be lowered and raised in a shallow shaft specially made for the purpose. The diameter of the drums is again varied as in the preceding case. Then still another method is in practice, in which an entirely different road is chosen for the counterbalance to work in; it may be in a direct line with the brow in which the load is being raised in an opposite direction, or at any angle from that road. Under advantageous circumstances, with a good road, not too steep inclination, and a good output, an endless rope or chain modification of the self-acting incline has been successfully adopted. In this arrangement two pulleys are necessary, one at the top and the other at the bottom; one of these must be placed upon a movable carriage, as in the ordinary endless haulage system to tighen the rope or chain as desired.

Return wheels such as shown in Fig. 1, are used on self-acting

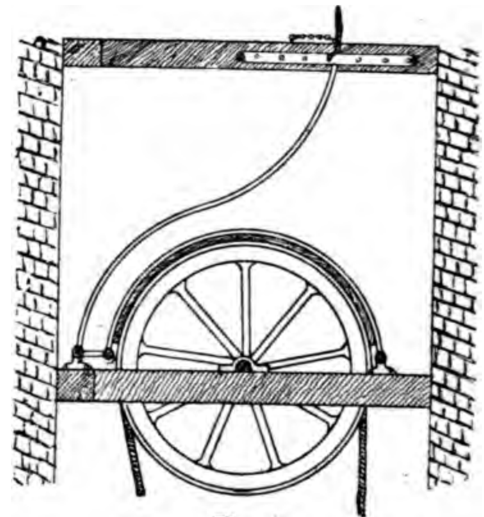


Fig. 1.

inclines for ordinary grades, but when the incline is very steep, say 1 in 6, it becomes necessary to adopt some means other than the ordinary pulley-wheel, as with this inclination the friction of the rope on the pulley may not be sufficient to hold the tubs when required. For steep inclines, therefore, an ordinary drum may be used with the rope coiled round several times to give it the necessary friction, or a specially constructed pulley may be used as the "Climax Grip Pulley" Fig. 2.

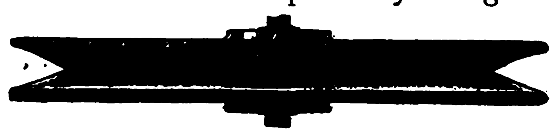


Fig. 2.

As will be seen by the illustration, the groove for the rope takes a spiral form, thereby making it impossible for the rope to slip. A brake is applied to the drum or wheel to regulate the speed of the tubs and to bring them to rest when required. The arrangement of the brake on a

wheel with a horizontal axis] is clearly shown by Fig. 1,[and consists of an iron strap passing half round the circumference of the wheel fastened to the framework at the bottom, and to a bent lever at the top; the other end of the lever is curved downward to a suitable height for the "jigger" to conveniently work. The depressing of the handle or long arm of the lever causes the iron strap to press upon the circumference of the wheel and thus decrease its speed; the handle may be kept in any required position by inserting an iron pin into the hole immediately above the handle in the piece of iron behind which the handle moves up and down. A good brake may be made by attaching tapered pieces of timber, suitably curved to the sweep of the wheel, to the iron strap by means of bolts, care being taken that the bolt heads are well countersunk, so as not to touch the rope or the efficiency of the brake will be minimised, and in all probability the rope will be damaged. Hemp is also used instead of the wood or in conjunction with the wood, but it does not last so long, though it is more effective.

Wheels are sometimes fixed with the axis vertical and sometimes horizontal, drums being always fixed with the axis horizontal. The advantage of the horizontal arrangement of the axis as shown in Fig. 1 is that very little lateral space is required, and a set of rails may be laid on each side, if the road extends to the back of the wheel as is often the case without necessitating a very wide road. The vertical axis is however the better arrangement for the same advantage of saving space, and even more can be obtained by fixing the wheel on suitable bearers above the road or under the rails. For an ordinary pulley the rope is coiled once and a half round, though with the grip pulley it is only necessary to have the rope applied to one half the circumference, *i.e.*, the back part of the wheel.

When drums are used they should be provided with all round brakes, as being employed on steep inclines it is essential that the brake should be as effective as possible in order to stop the tubs at any point in a short time; the rope is of course coiled round the drum several times to prevent it from slipping.

Friction rollers (Fig 3) are laid at intervals of about 10 yards between the rails, to allow the rope to run upon them to prevent its being damaged and to lessen the amount of friction, as the difference of rollers may mean the proper working or otherwise of an incline where the

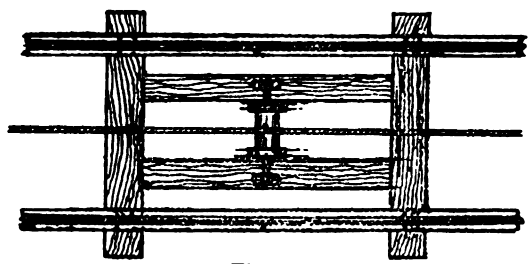


Fig. 3.

inclination is barely sufficient. The roller consists of a solid cylindrical piece of iron from 4 to 6 inches diameter and about 10 inches long, with axles that work in suitable bearings fixed on to a wooden frame; the bearings should be kept constantly oiled and the box or hole under the roller kept free from dirt and stones.

The necessary signals to communicate between the ends of the incline is usually performed by means of a hammer rapper (Fig. 4) though of

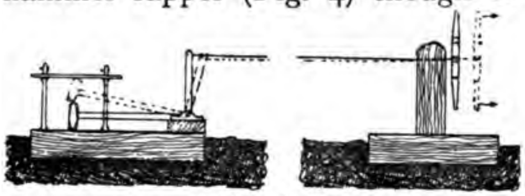


Fig. 4.

ate, electric signalling has been applied to inclines of great length. The rapper consists of a wire which is carried along the length of the plane, supported at intervals by staples knocked into the props or bars in suitable positions and attached to a lever or handle at the bottom of the incline and to the lever handle of a hammer at the top. It is only necessary to communicate signals from the bottom to the top, as the jigger knows when everything is ready at the top, and the signals acquaint him with what is going on at the bottom. When the attendant at the bottom wishes to signal to the top he pulls the handle in the direction of the arrows and the hammer is jerked against the iron plate fixed upon iron uprights immediately above the hammer. The plate is supported by four uprights, the narrower part of the uprights at the top fitting into holes in the plate; about an inch above the plate, cotters are fixed in the uprights to prevent the plate from being knocked off, and in this manner the plate is allowed about an inch play on the uprights, so that it will give a clearer sound. While the full tubs are accumulating at the top in preparation for another "set" or "train," it is necessary to have some arrangement to prevent them from running down the incline before the rope is attached and everything ready. The stop most commonly used for this purpose is shown by Fig. 5. Two pieces of wood are

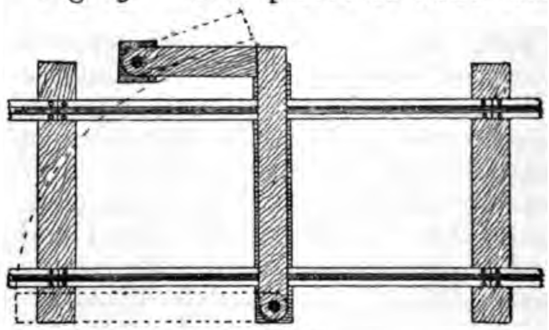


Fig. 5.

used about 5 inches square, working upon pivots, one piece (the longer) can be stretched across the road as shown, and kept in position by means of the shorter piece. When it is necessary to allow the tubs to run down the incline, the two pieces are knocked into the position shown by the dotted lines. When only a few tubs constitute a set the piece for crossing the rails may be made shorter with its pivot in the centre of the road. An automatic catch (Fig 6) is usually fixed on the empty

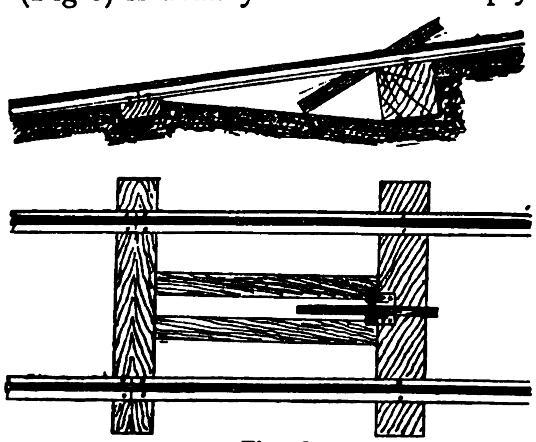


Fig. 6.

tub side at the top, which prevents any tubs from going down, but

ws them to come up. The ıngement can be easily under- ›d by reference to the figure. It sists of a piece of iron about 12 ıes long (the lower part being the vier) working on a pivot attached : sleeper in the centre of the road. ͻ tubs when coming up the ine push the iron catch down, immediately they have passed weight of the lower part causes catch to assume its original :ical position, and as it cannot ⁄e further in the opposite direction axle of the tub coming down is ght by it and the tub is prevented n running down the incline.

*(To be continued.)*

## RIZE COMPETITION.

### QUESTION PRIZES.

prize of one shilling will be given for the original answer to each of the questions n below. The editor's decision to be . A competitor may answer any number uestions in one stage; but he must ıne himself to that particular stage.

S.—The questions for Managers and ours to be classed as one stage. Com- ors must adhere to the following rules:—

t—All envelopes must be marked MPETITION."

ıd—To be written on separate sheets of ːr with name attached, and on one side ıe paper only.

d—Correct name and postal address t be sent.

h—They must reach us by January ·, 1894.

*uestion* 1. (E.)—What is a fault? Describe ı sketches an ordinary and reversed fault.

*uestion* 2. (E.)—State the relative advan- ːs, and the weight and dimensions of the ːrent mining picks with which you may cquainted.

*uestion* 3. (E.)—Enumerate the pre- :ions to be taken against accidents in ving or winding shafts.

*Question* 4. (A.)—What are the advantages and disadvantages of rope boring?

*Question* 5. (A.)—State the relative advantages of wooden and iron tubs.

*Question* 6. (A.)—What different kinds of ropes are used in mining, and state their relative efficiency?

*Question* 7. (H.)—State what conditions would guide you as to the size of a proposed shaft. Give an example.

*Question* 8. (H.)—What are the constituents of fire-damp? What is its specific gravity, where and when would you expect to find it, and how is it found?

*Question* 9 (M.)—In longwall workings, explain minutely what is meant by having "the weight" on the face. If too much weight was on the coal, causing it to be crushed into dross, what means would you take to remedy it? If the weight was not sufficient to help the miner as he would like, what would you do to bring it on? Having got it, how would try to keep it regularly on the face? Would you use the same measures at 15 fathoms, as you would at 90 fathoms deep.

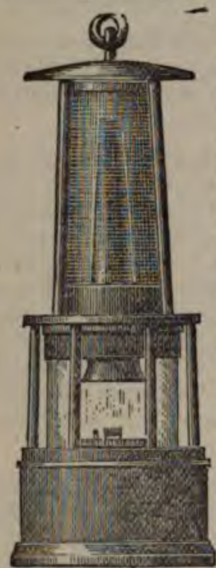
*Question* 10. (M.)—Sketch and describe how you would take out a section of coal pillar 36 yards square, with average roof, and what are the chief points to aim at, and what to avoid in order that as little coal and propwood may be lost as possible.

## ANSWERS TO QUESTIONS

**In No. 2, Vol. 2.**

*Question* 1. (E.)—Describe, with sketch, the Mueseler Lamp.

*Answer.*—This lamp is of the Clanny type and contains a conical metal chimney in the centre of the lamp within the gauze which carries off the products of combustion, the chimney being supported by a ring of gauze at its base which extends to the bottom of the vertical gauze. The feeder of air passes through the vertical gauze and then downwards through the horizontal gauze ring to the flame of the lamp, and the products of combustion pass up the conical metal chimney and out of the top of the lamp, and only through one partition of gauze. It is very quickly extinguished if held in an inclined position or upset. It will explode in velocities between 1,000 and 2,000 feet per minute. An explosion inside the lamp is prevented at ordinary velocities by the dead air in the conical chimney. The shield consists of a conical sheet-iron shell called a bonnet. It covers the gauze and greatly increases the safety of the lamp, so much so that in this case an unbonneted Mueseler explodes at 22 feet per second velocity, and a bonneted Mueseler is safe at 40 feet per second.



JOHN LAXTON,
17, Smithy Green,
near Barnsley.

*Question* 2. (E.)—What is cannel coal, and under what conditions is it generally found?

*Answer.*—Cannel coal is a brown-black coal with a very dull lustre. It is also very compact and breaks with a conchoidal or shell-like fracture. It does not soil the fingers when handled and can be cut and shaped into ornaments. It kindles readily, burns freely and quickly, and is especially valuable for gas-making, being principally used for the manufacture of illuminating gas, Its composition is as follows:—C 84%, H 6%. O and N 10%. It is probably of subaq[u] origin as it often contains fossil fishes, [a] found in saucer-like layers which thin at the edges.

MATTHEW MOURLEY,
Rock Terrace,
Soothill Lane,
Batley, Y

*Question* 3. (E.)—What are minerals [a] term is understood by miners?

*Answer.*—Minerals as understood by mi[ners] are deposits of commercial value, o[r] object of the miner's search. They a[re] be found as stratified and unstrat[ified]. Those found as stratified are :—Coal, stone, Rock Salt, Firestone or Gan[nister] Manganese. Those that are stratifie[d] found in veins, and are all metallic ores

G. WM. COLLINGWOOD,
Elm Park Terrace,
near Tow Law
Dur

*Question* 4. (A.)—Describe, with sketc[h] Capel Fan.

*Answer.*—The Capel Fan was invent[ed] 1883. It is a swift-running fan and v[aries] in diameter from 8 to 15 feet, and in w[idth] from 4 feet to 11 feet 6 inches. It is m[ade] to receive the air on one or [both] sides, and is therefore a single or do[uble] in-let fan as desired. The air received f[rom] the mine is drawn in at in-lets, and esc[apes] from those in-lets through a series of port[s] into the outer chamber, from which it esc[apes] into the evasee chimney which reduces [its] high velocity before passing into the at[mos]phere. The number of revolutions it m[akes]

per minute varies, and may be from 180 to 300. It is a fan capable of circulating large volumes of air per minute. This fan is worked by the second motion by means of a series of ropes, or a belt from the pulley or drum of engine to pulley or drum on the fan shaft, but recently it has been erected to work direct acting or by first motion. It is a fan which is coming into great use, because the cost of foundation and buildings is not great, and the shaft passing through the fan is comparatively light, which enables it to run smoothly and with an absence of heating at journals.

W. T. HEWITT,
Queen Street, Eastwood, Notts.

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*Question* 5. (A.)—Explain the theory of the ventilation of mines, and what are the advantages of large air-ways?

*Answer.*—General Rule (1) of the C.M.R.A. requires that an adequate amount of ventilation shall be constantly kept up in every mine to render harmless noxious gases to such an extent that the working-places of the shafts, levels, stables, and workings of such mine, and the travelling roads to and from such working-places shall be in a fit state for working and passing therein. The meaning of ventilation, as applied to mining, is that a sufficient quantity of air must be circulated through the galleries of a mine for the respiration of men and animals, and for the combustion of lights. Air, like all other inert bodies, remains at rest or always in the same state of motion until force is applied. To comply with General Rule we must have in the mine a continual current of fresh air. To produce this current there are different kinds of appliances. There are the furnace, centrifugal ventilators, water trompe and steam jet, and in some mines which are of small area a natural current of air may be produced. Air, when heated, becomes rarefied, that is, it is made lighter than the surrounding air which forces the lighter air upwards. This occurs in natural ventilation where the combustion of lights, the respiration of men and animals, and chemical action, so rarefies the air as to cause a current of air to pass around the workings. There must be two shafts, the one to be the inlet and the other the outlet.

In furnace ventilation a furnace is placed at the bottom of the up-cast shaft. The air becomes heated as it passes over the furnace, becoming lighter, and rises upwards towards the surface. As air is impenetratable, other air follows filling up the space which would have been left had such not been the case. The air from the surface thus being heavier than that which passes up the up-cast passes into the mine, passing along the main in-take, where it is stopped from quickly returning to the up-cast shaft by brick stoppings and fast doors on either side of the road, and back to the up-cast by the main return.

Centrifugal ventilation.—A fan is placed at the surface, and is connected to the up-cast shaft by a drift. As the fan revolves, air is thrown from the centre which tends to cause a vacuum, but as air is impenetratable other air rushes through the mine to fill up the vacuum likely to have been left. A fan may be either made to force the air around the workings by placing it at the top of the down-cast shaft and reversing its revolutions, or ventilate by centrifugal force by placing it at the top of the up-cast as already described.

In ventilation by water trompe, water is made to fall through a vertical pipe in the down-cast. Air passes into the pipe through openings at the side, and is carried down the pipe by the force of the waterfall. At the bottom is a board on which the water falls and passes away on the one side, while the air being separated from the water rises upwards, passing through a pipe into the workings of the mine.

In steam jet ventilation, a jet of steam is made to pass up the up-cast. This rarefies the air in the same manner as the furnace, but not to such an extent.

Large airways are advantageous for the ventilation of a mine, insomuch as the resistance increases inversely as the area of the air passage. Thus, if it takes a force equal to 4 H.P. to produce 30,000 feet of air per minute in an air passage of 64 sq. feet, it will take a force of 16 H.P. to produce the same quantity in the same time in an air passage 32 sq. feet. The air passage being only half the size of the larger one, the power to overcome the resistance is the square of the power to overcome the resistance. As the small passage is 32 feet in area and the large passage twice that size (64 feet), then the power required is $4^2$ or $4 \times 4$ which equals 16 H.P. required. Thus the advantage of a large airway is that a greater

amount of air can be carried through a mine with the same amount of H.P., as less resistance to the air current is met with.

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Murton Colliery,
Sunderland.

*Question* 6. (A.)—Find the square root of 994,009.

*Answer.*—

| | | *Proof*:— |
|---|---|---|
| 9 | 994009 (997 | 997 |
| | 81 | 997 |
| 189 | 1840 | 6979 |
| | 1701 | 8973 |
| | | 8973 |
| 1987 | 13909 | |
| | 13909 | 994009 |

∴ 997 is the square root of 994009.

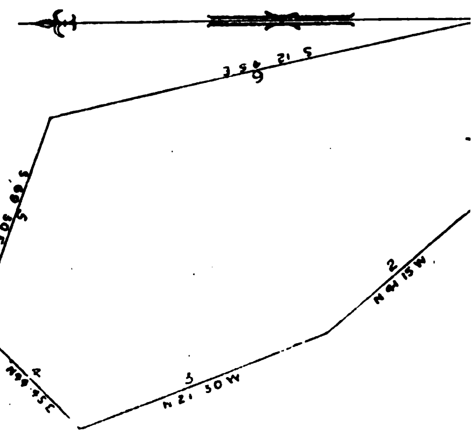
After pointing or dotting, according to the rule, we take the first period or 99, and find the greatest number whose square is contained in it. Since the square of 9 is 81, and that of 10 is 100, it is clear that 9 is the greatest number whose square is contained in 99; therefore I place 9 in the form of a quotient to the right of the given number. Square this number and put down the square under the 99; subtract it from the 99, and to the remaining 18 affix the next period 40, thus forming the number 1,840. Take 2 × 9 or 18 for a divisor; divide the 1840, omitting the last figure, that is, divide the 184 by the 18, and we obtain 10, but 10 won't do, so we try 9. Annex the 9 to the 9 before obtained and to the divisor 18; then multiply the 189 by the 9. We obtain 1701; subtract this from the 1840, and to the remaining 139 affix the next period 09, thus forming the number 13909. Take 2 × 99 or 198 for a divisor; divide the 13909, omitting the last figure as before, that is, divide the 1390 by the 198, and we obtain 7. Annex the 7 to the 99 before obtained, and to the divisor 198; then multiply the 1987 by the 7 we obtain 13909, which, being subtracted from the 13909 before formed, leaves no remainder; therefore 997 is the square root of 994,009. The square root of any number can be found by the above reasoning.

JOSEPH WHEATCROFT,
8, Longsight Terrace,
Kinsley Hemsworth,
near Wakefield.

*Question* 7. (H.)—Plot on paper (in inl any scale, the following survey:—

| | | | |
|---|---|---|---|
| N. | 85 | W. | 665 links. |
| N. | 41·15 | W. | 705 „ |
| N. | 21·30 | W. | 950 „ |
| N. | 44·45 | E. | 522 „ |
| S. | 69·30 | E. | 800 „ |
| S. | 12·45 | E. | 1605 „ |

*Answer.*—



THOS. BARNES,
Church Road,
Haydock, Lancas

*Question* 8. (H.)—In obtaining inform from old plans what precautions would take, and how would you form an approxi idea of its date?

*Answer.*—I would first of all observe date marked on the plan and by allowi variation of 7 min. per year, or by refe to a correct table of variations, c ascertain the present bearing of such places, and would then with a certain de of safety be able to approach them. If, ever, no date is affixed but only a vari is marked thereon, then the date may be found, and bearings again ascerta As for example, suppose variation record be 21° W., then knowing the present vari of the vicinity (which is, say 18° W.), it be reasonably admitted that the plan made about the year 1867, since 21 18° = 3° or 180′. Then 180′ ÷ 7′ (an average variation) = 26, and 1893 — 1867. Then again, there is the possil of neither the date nor the variation b marked on, in which case I would find variation as follows:—I would find, means of a dial or theodolite, the bearii

a supposed line drawn between two buildings or anything shown on the plan of the surface. Next, by means of a protractor, I would find the bearing of this line from the old meridian, and in this manner find the variation. The date could then be approximately ascertained by the means above described.

JNO. LAVERICK,
Eppleton Colliery,
Hetton-le-Hole, R.S.O.

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*Question* 9. (M.)—Describe the bricking scaffold you would use in a sinking pit. State how you would support it when in use, how you would raise and lower it, and what you would do with it when not in use.

*Answer.*—I would use a form which is now coming into use at large collieries. It is made of "grid-iron" so as to allow for ventilation, and is supported by two ropes which pass over pullies and are wound on a capstan or drum which may be geared to the engine used for sinking. The scaffold is connected to the ropes by means of four chains, at equal distances from each other round the edge of the scaffold, two chains to each rope, and meeting at a point where the chains are connected to the ropes. By using a guide bar the ropes are made to answer the purpose of guide rods, which prevent the swinging of the hoppet. An orifice is left in the scaffold about six inches wider than the hoppet, through which the hoppet can pass freely. The scaffold is raised and lowered by the guide-ropes, worked by an engine on the surface. The advantages are:—(1) It is not in the way when out of use. (2) It is easily raised and lowered. (3) Small cost, since the guide-rope can be used for other purposes when the sinking is finished. (4 and perhaps best of all) The scaffold acts as a means of protection to the sinkers from anything tumbling down the shaft.

WILLIAM HALLIWELL,
9, Railway Street, Wigan.

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*Question* 10. (M.)—If accumulations of explosive gas or other poisonous gases should be met with in a mine, what steps would you take?

*Answer.*—In dealing with a large accumulation of gas, I should not commence operations until all the men except those assisting in the removal thereof were out of the mine, and that no man or light were under any conditions on the return side of the gas. I should then begin by forcing the air current into it, on the in-take side, gradually driving it out by degrees. If the ordinary current was not strong enough for this purpose I should close some of the other splits, thus increasing the w.-g. produced by the same power. If it was a furnace-ventilated mine having no dumb-drift, and the air was not safe to pass over the furnace, I should partly open the main separation doors and allow a sufficient quantity of fresh air to mix with the return, so that it would be safe to pass over the fire. Two very careful men would have to be placed in charge of the doors to regulate the quantity of air passing through them. If I found that it was dangerous to work as described, it would perhaps be necessary to put the furnace out, and fix a waterfall in the down-cast, or a steam jet in the up-cast. After the gas had been cleared away I would make an examination with a locked safety lamp, and if I found that it was safe I should enter a report to that effect in the report book.

JOHN WORRALL,
21, Wigan Road,
Westhoughton, Lanc.

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## CORRESPONDENCE.

December, 1893.

*To the Editor of "Mining."*

Dear Sir,

Will some of your readers kindly answer the following question and oblige?

In boring against water or old workings, how would you set the boreholes away and get the drills to their proper angle.?

Yours truly,
A. A.

---

THE COLLIERY FIREMAN,
Wigan, Jan. 1st, 1894.

*To the Editor of "Mining."*

Sir,

With reference to the duties of the colliery fireman, I find your correspondent, "Fireman," agrees with me in saying that he considers it impossible for a person to discharge the duties of the fireman through being able to write. I find also, that "Fireman" is of opinion that an examination should be passed. Another correspondent,

"Incedo," informs me that "there are collieries in the County of Durham where the deputies or firemen keep their report books at home, only taking them to the office to be signed by the manager." "Incedo" leaves me to form my own opinion as to how the reports are made out. Of course, if he cannot write himself he will certainly have ample opportunity of obtaining the aid of someone who can (perhaps one of his children). But in the collieries in this district the report books are not taken home. The fireman makes his report, a specimen of which I gave in my last communication, in his own handwriting. Besides the report books required by rule 4, there is the sudden danger book, rule 7, the book in which the result of the inspection of machinery is recorded, and also where the system of having a 'head' or first fireman prevails, he has to book all the time, and frequently has to write and re-write the names of all persons in the mine or district of the mine under his charge. Then we have the labour book. In the majority of well managed mines a labour book is provided, in which is recorded the particular work of each dataller for each shift, and the place where such work has been performed. Besides these, there are many circumstances occurring which necessitate a note being written for timber, to the under-manager, who may be at the surface or in another mine, for the blacksmith, etc., etc. In fact, I should not like the position of fireman if I was ignorant of the art of writing. Considering the above, it will be seen that in this district, and where the system prevails (which is a system to be encouraged), a person cannot possibly perform the duties of a fireman if he cannot write. Then as to the question of keeping the report books in a place, on the door of which is printed the words "No admittance except on business." It must be remembered by "Incedo" that a workman has business in any place where report books are kept. Let him turn to general rule 4, which specifies that the report books shall be "accessible to the workmen. Hoping I have not trespassed too much on your time and space.

I remain,

Yours, &c.,

"Firo."

## ANSWERS TO CORRESPONDENTS.

D. W. writes from Barnsley to the effect that he is forty-eight years of age, is at present acting as a timberman; has a fair knowledge of arithmetic and some little knowledge of algebra, but is not able to draw, and knows little of mensuration. He wishes us to give him information as to the advisability of studying with a view to obtaining a First-class Certificate of Competency, and give him private lessons of correspondence.—— We would be glad to help D. W. to obtain a Certificate, but we would not advise him to inconvenience himself in attempting to secure one, as it is improbable that it will bring him any remuneration at his age, taking into consideration his present position. If, however, he has plenty of spare time, he may with advantage spend some of it in studying. He should carefully read his "Mining," and work out all examples appearing therein, as well as the Competition Questions. If he so desires we will check his questions on other work of any kind, and will offer advice in the various branches of science in which he may be deficient, at a nominal cost, to defray expenses. As to the number of volumes to which this paper will extend we are altogether unable to say, but hope they will run into a good number. As will be seen in other parts of the paper, Vol. I., which forms a very good text-book, can be had at this office at a very reasonable cost. We will at all times be glad to hear from D. W.

Elementary Student.—Yes, we have seen Mr. Peele's recent book of Elementary Mining, and can strongly recommend it as the best elementary text-book published at anything like the price.

Beginner in Surveying.—We have placed your suggestion before the writer of the Surveying articles and he has kindly promised to give private information (on receipt of a stamped addressed envelope) to such as cannot fully understand anything published in his articles, as he is aware that no matter how lucid the articles may be written, there will be some points which will be difficult for the beginner to master. If, at any time, the difficulty of the subject is such as to guarantee a fuller and more elaborate explanation, it shall be referred to again. In fact, nothing shall be wanting to make the articles as thorough and useful as possible.

*Printed and Published* by Strowger and Son, Clarence Yard, Wallgate, Wigan.


o 5. Vol. II. SATURDAY, JANUARY 27, 1894. FORTNIGHTLY. ONE PENNY.

## CONTENTS.



# EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in Number 2, Volume II.*

## GEOMETRY.—(Contd.)

VI. To construct a triangle equivalent to a given quadrilateral ABCD (Fig. 39). Join BD, and from C draw CE parallel to DB; then join DE, and ADE is the required triangle equivalent to ABCD.

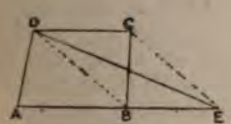



Fig. 39.

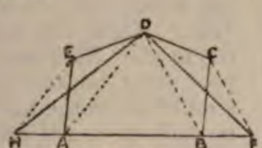



Fig. 40.

VII. To construct a triangle equivalent to a given polygon ABCDE (Fig. 40). Join DB, and from C draw CF parallel to DB. Then join DF, and the quadrilateral figure AFDE is equivalent to the polygon ABCDE. Thus the question now resolves into constructing a triangle equal to the quadrilateral figure AFDE. Join DA, and from E draw EH parallel to DA. Join DH, and DHF is the required triangle equivalent to ABCDE. By this method a triangle may be constructed equivalent to an irregular figure of any number of sides, by reducing the number of sides by one each time, and the area or quantity of the figure can be arrived at by taking the area of the equivalent triangle, thus superceding the old-fashioned method of computing areas by dividing the figure in a number of small triangles and calculating the area of each separately. This part of the subject is so important that we will refer to it again, and show by practical examples how it is performed.

VIII. At a given point in a given line to make an angle of a given number of degrees. Before we attempt to describe the manner in which this is done, it would be well to know properly what is meant by a degree.

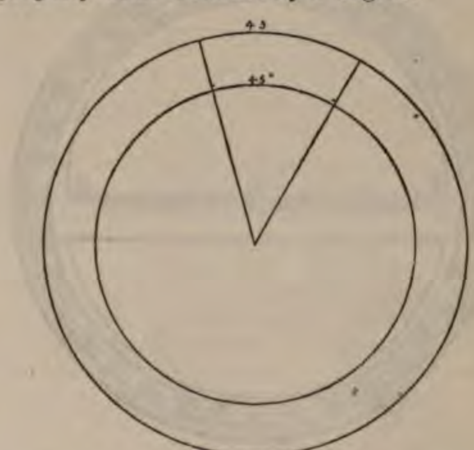



Fig. 41.

Diagram showing that angles of equal number of degrees drawn from different circles are equal.

Let us take a circle of any magnitude (Fig. 41 will answer our purpose) and divide the circumference into 360 equal divisions. Then each of these divisions is a degree, that is, the angle contained by two lines

drawn from the centre to the circumference, and enclosing exactly one division, is called a degree. In the same manner, the $\frac{1}{360}$th part of the circumference of all circles contains a degree, and all degrees are equal. For, as was explained previously in the definitions, it is not the length of the lines which enclose the angle that determine its magnitdue, but the distance between the lines at a definite distance from the point of intersection. Thus it is easy to understand that, if two lines be drawn at right angles to each other through the centre of a circle, the circle contains four right angles, no matter what the size of the circle may be, and as a right angle contains 90 degrees, four right angles equal 360 degrees. Degrees are sub-divided into minutes, and minutes are again sub-divided into seconds. Thus 60 seconds equal one minute, and 60 minutes equals one degree. For convenience and despatch in writing, a degree is denoted by a small o being placed at the top right-hand corner of the figure, a minute by a dash (′), and a second by two dashes (″), as $42^{\circ}, 3', 45''$, which is equivalent to saying 42 degrees, 3 minutes, 45 seconds. The angle indicated by seconds is so small that the student can entirely discard it. We think that by this explanation we have gained the point of enabling the student to understand what is meant by a degree.

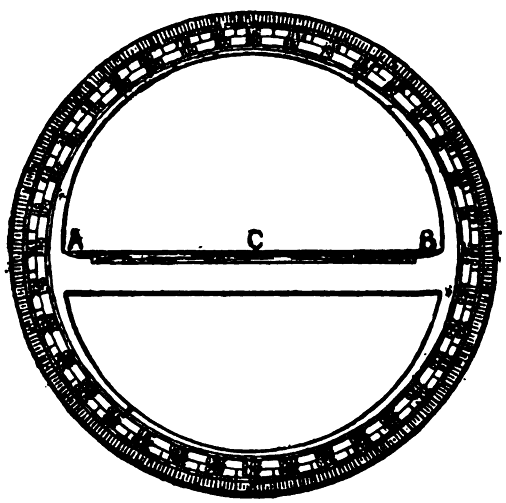



Fig. 42.

Angles of a definite number of degrees are usually made in practice by means of a protractor. There are several kinds of this instrument: the semi-circular, the circular, and the cardboard. Semi-circular protractors are usually the small imperfect class generally found in conjunction with a box of mathematical instruments. They are only fit for rough work. The circular (Fig. 42) is usually made of brass or electrum, about a foot diameter, and is most commonly used. Some of the more recent ones are fitted with arms and verniers for the more accurate adjustment. These we will illustrate and describe at a later period. The cardboard protractor consists of a piece of cardboard, 21 inches square from the centre of which a circular piece, 12 inches diameter, is cut out, the degrees being marked round the edge. This class is undoubtedly the best for mine surveys of ordinary scales, and will be more fully described later on. In the ordinary circular protractor (Fig. 42) the brass or electrum ring is marked with the divisions of degrees round its circumference. Extending across the ring is a bar, AB, of the same metal as the outside ring. One of its sides is feather-edged, and is exactly in line with the divisions 360 (or 0) and 180, and the centre (C) of the protractor is marked on this line.

We will now return to the problem. Let DE (Fig. 43) be the given line, and F the given point, and say it is required to make an angle DFH equal to 45 degrees.

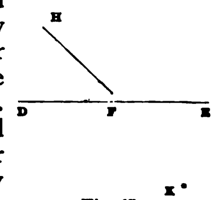



Fig. 43.

Place the protractor with its centre point C exactly on F, and the upper or feather-edged side of the bar AB in line with DE. Then the divisions 360 and 180 are immediately over the line DE. Next, by means of a pricker, make a mark on the paper at the division 45 on the protractor. Let this point be H. Join HF. Then the angle DFH is the angle required. Suppose the division 225 on the protractor be also marked off at K, then K should be in the same line as HF, so that it is well to mark off the divisions on both sides, to act as a check on the work.

IX. To find the number of degrees a given angle contains.

In this case the protractor is simply placed with the feather-edged side of the bar, or its centre line, along one of the lines of the angle, and with its centre point at the point of intersection of the two lines, and the position of this line with respect to divisions on the protractor is read off.

*(To be continued.)*

# EXAMINATION QUESTIONS,
### With Answers,
**By a First-Class Certificated Manager.**

The following questions were given at the Examination of Candidates for Certificates of Competency, in the Manchester District, December, 1892.

### Arithmetic.

QUESTION 1.—Express 8 cwt. 3 qrs. as the decimal of a Ton.

ANSWER.—Reduce 3 qrs. to decimal of 1 cwt. Thus $\frac{3}{4} = \cdot 75$. Place 8 cwt. on left side of this point, and reduce this to decimal of a ton. Thus, $\frac{8\cdot 75}{20} = \cdot 4375$.—Answer.

To express a given quantity as the decimal of another term of quantity, the following rule may be adopted:—

RULE.—Put down the lowest term and and reduce this to the decimal of the next higher term. Then place on the left of this point obtained the next higher term, and reduce this again to the next superior term, and so on, until you arrive at the term required.

QUESTION 2.—Divide 1·1214 by 5·34.

ANSWER.—$\frac{1\cdot 1214}{5\cdot 34} = 0\cdot 21$.—Answer.

$$5\cdot 34 \overline{)\, 1\cdot 1214\,} (0\cdot 21.\text{—Answer.}$$
$$\begin{array}{r} 1\,068 \\ \hline 534 \\ 534 \\ \hline \dots \end{array}$$

QUESTION 3.—A block of coal is 1 acre, 2 roods, 10 perches (Statute measure) in area, and its thickness is 4 feet, 3 inches. What weight of coal is there in the block, reckoning 18 cwt. to the cubic yard?

(Answer in the Competition Question in present issue.)

### Practical Mechanics.

QUESTION 4.—A double-acting pumping engine, with ram 7 inches in diameter and 2 feet stroke, is required to pump up a shaft 175 yards in depth, with a steam pressure of 45 pounds per square inch at the engine. What diameter must the steam cylinder be (allowing one-fifth to overcome friction), and what quality of water would be pumped at 20 revolutions per minute?

ANSWER.—Pressure per square inch on pump $= \frac{525 \times 15}{34} = 231\cdot 6$.

Area (in square inches) of ram $= 38\cdot 48$.

Total pressure to be overcome $= 231\cdot 6 \times 38\cdot 48 = 8911\cdot 966$.

Piston area $= \frac{8911\cdot 966}{45 \times \cdot 7854} = 252\cdot 156$.

Diameter of cylinder $= \sqrt{256\cdot 156} + \frac{1}{5} =$ 17·39 diameter in inches.

Quantity of water pumped per minute $= 7 \times 7 \times \cdot 034 \times 2 \times 20 \times 2 = 133\cdot 33$.

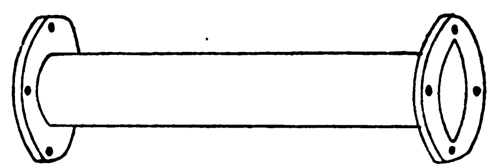
133·33 gallons per minute.—Answer.

QUESTION 5.—The weight of coal and the rope wound at a shaft, 550 yards in depth, in one minute being $4\frac{1}{4}$ tons, what is the effective horse-power of the engine?

ANSWER.—The horse-power of engine $= \frac{2240 \times 4\cdot 25 \times 1650}{33000} = 184$ H. P.—Answer.

QUESTION 6.—In putting steam pipes in shafts, how would you provide for contraction and expansion? Give sketches for 5-inch cast-iron pipes, and for 2-inch wrought-iron pipes.

ANSWER.—I would put an expansion joint in for every 80 yards in depth.



QUESTION 7.—In preparing a self-acting incline how would you arrange the gradients at the top and bottom of the plane? Show, with a sketch, the brake you prefer.

ANSWER.—I should arrange that the bottom of incline be flat to assist the full boxes with ease to start off when ready; besides this, it is easier to change the boxes and prepare them for ascending incline. Top of incline should be of a steeper gradient, except the landing place and shunt which should be nearly level, so that the boxes can easily be changed and arranged in sets or gangs, according to the number of boxes required for each journey.

**(Sketch of suitable brake appeared in last issue.)**

*(To be continued.)*

# HAULAGE.

## Chapter VI.

### Position of Boilers, Engines, &c.

It is only under the most advantageous circumstances that coal seams can be won without some mechanical power to convey the coals to the shaft, in fact it is doubtful if there is any extensive colliery extant where mechanical power is entirely dispensed with for this purpose, for, even supposing that a shaft is sunk at the centre of a coalfield which forms a basin, it is very probable that the dislocations of the seams (from which no coalfield is free) will necessitate the employment of machinery.

The various systems of haulage by machinery may be classed under three heads, viz. :—

(1) Direct.
(2) Main and Tail Rope.
(3) Endless Rope or Chain.

The motive power most generally used for the working of these various systems is steam, though of recent years compressed air has been much employed. The advantages of compressed air for haulage are—facility in conducting it to any part of the mine, ventilation assisted by it, no exhaust to be conducted away, and mine kept cool. Its disadvantages are loss of power, great cost, and a steam engine is required to generate its power. The disadvantages of steam are condensation when carried long distances, necessity of removing the exhaust as it is destructive to the roof of mine, etc. The general prevailing feeling with regard to the use of compressed air is thoroughly expressed by the remark made by a colliery manager at whose collieries it was used. "It is very convenient now that we've got it, but its first cost was discouraging."

The boilers necessary to generate the steam for the haulage plant were in previous years, often placed in the mine itself, in close proximity to the upcast shaft, but this is seldom if ever done now. The advantage of having the boilers near the engines is of no small account; but the disadvantages accruing from this position, consisting principally of the danger of fires underground, the difficulty and inconvenience of inspection, and the injurious effect of the gases to the shaft, entirely over rules this advantage. Then again the engines are now in many instances placed in proximity to the boilers on the surface, and the haulage ropes are conducted down the shaft, thereby gaining the same advantage; but the arrangement has its disadvantages, the principal of which is the guiding of the ropes down the shaft, and the greater amount of power necessary from this cause. Yet we consider that in almost all cases this arrangement is the best, though there are few exceptional cases where the engines can with advantage be placed underground. When compressed air is used, the power is generated by suitable machinery on the surface and conveyed to the engines below in pipes. Receivers are usually placed near each engine.

### Direct Haulage.

This system of haulage is employed when the inclination of the road from the shaft is sufficient to enable the empty tubs to run back by the force of gravity, and drag

the rope, from the drum of a fixed engine, with them; the minimum inclination for this arrangement being about 1 in 30. The simplicity of the direct haulage system is such that scarcely any description is necessary. The full tubs at the bottom of the brow are attached to a rope, the other end of which winds on the drum of a stationary engine. The signal being given the full tubs are pulled up, the rope detached and then fastened to the end tub of a set of empties which is usually waiting. The drum is thrown out of gear, and the empty tubs running back are sufficient to unwind the rope from the drum. It will be apparent therefore that only one line of rails are necessary throughout the brow, though it is usual to have double lines of rails at each extremity of the plane to afford siding room for the "set" in preparation, and thus all delay is avoided.

In many cases the inclination of the road is more than sufficient for the empties to drag back the rope, when it becomes necessary to apply the brake to prevent the gang acquiring too great a speed; six miles an hour being a fair average for this system of haulage. If the nature of the road however admits of two lines of rails being laid, the surplus power may be utilised to help the engine, and a large number of tubs may be hauled in a given time. Two ropes are then used, as both "gangs" or "sets" of full and empty tubs are travelling at the same time. The arrangement may be likened to a self-acting incline, and is clearly shown by Fig. 1. The ropes may

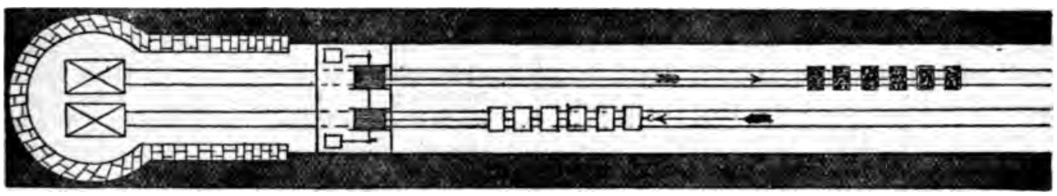
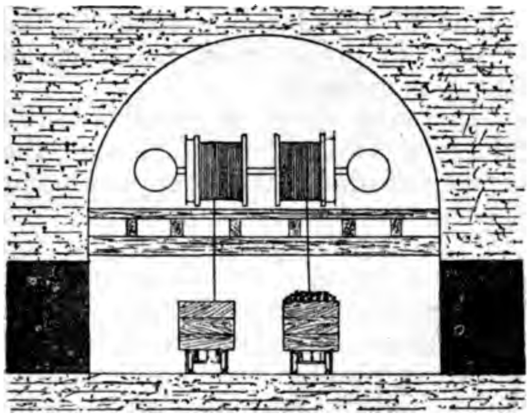


Fig. 1.

be wound upon one drum as is the case in the ordinary winding engine, or upon two drums, as shown in figure, working upon the same axle. In the instance illustrated the road extends directly to the pit, so that the engine must be placed in such a manner as not to interfere with the passage of the tubs. The manner in which this is accomplished is shewn by the cross-section of the road (Fig. 2). Here it will be seen the engine is placed upon a suitable bed of timber, fixed at sufficient height above the road to allow for the passage of the tubs travelling, &c. The direct haulage system is very convenient in some mines, as one engine and rope may be made to convey the coals from numerous roads in different directions, winding from each alternately when the supply from one district is not sufficient to keep the engine at work. In order to prevent the tubs from running off the rails and the rope from bearing against the side, numerous roller pullies must be fixed on the side. The pulleys are similar to those fixed in the centre of the road, but in this case the axis is vertical. At shank corners several pulleys are fitted, only two feet apart, between two horizontal pieces of



timber. The top bar of timber is faced with iron, and its distance from the centre of the road is only sufficient to allow the tubs to pass, so that the tubs press upon this timber and are thus guided round the corner. It is also usual to fix check rails at this point for the same end. By these means the rope may be made to work properly even round angles of 90 degrees. When the full tubs are ascending, a devil is attached behind to stop the train in the event of the rope breaking. There is however nothing to prevent the empty set from running away if the rope breaks in the descent, as is also the case with the full tubs, on self-acting inclines, and in the latter case especially, is something needed, as many accidents and much expense from the breakage of tubs is occasioned from this cause. The connecting hook for attaching the rope to the first tub is similar to that used in the main and tail rope method, which will be next described. In steep mines, and especially those in which the men are allowed to ride in the tubs, it is necessary to take measures to prevent accident, in case a coupling broke or became loose. The usual remedy for this is to attach a strong chain to the coupling of the first tub and the rope, carry it either over or under the whole of the tubs and fasten it to the last tub. It is left slack so that it does not come into use unless the couplings give way.

*(To be continued.)*

## ANSWERS TO CORRESPONDENTS.

W. B. (Thatto Heath).—We will insert what you require in our next issue, under the head of "Information to Candidates."

Cratos.—Loose powder is not allowed down a mine by the C.M.R.A., for the reason expressed in the answer to Question 2., No. 3, Vol. 1, but our Sub-Editor did not think fit to mention this as the question simply said "gunpowder for blasting," and no reference was made to its use in mines. The question is taken from an Examination Paper, and is answered as it should be. We disagree with Cratos in saying that the charge cannot be regulated better with loose powder than with cartridges.

F. H., and Others.—Glad you like the appearance of Volume I. It is as you say, undoubtedly cheap, and its sale has far exceeded our highest anticipation. We hope that our future issues will satisfy you as well as our previous ones.

T. M. (Barnsley) and Others.—The answer to Question 6 in No. 3, Vol. II., is correct, but one of the signs has been printed wrong. Instead $123\frac{1}{2} \times \cdot 7854$ it should be $123\frac{1}{2} \div \cdot 7854$.

## NOTICES.

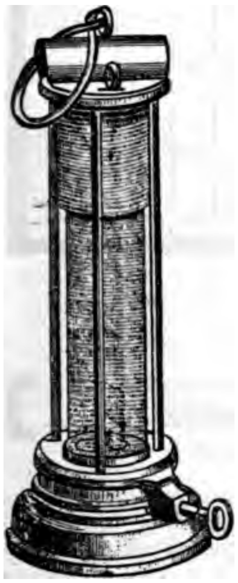
All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to Strowger and Son, Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

## ANSWERS TO QUESTIONS
### In No. 3, Vol. 2.

*Question* 1. (E.)—What are the essential points in the construction of the *Davy* Lamp, and with what velocity of air does it become insecure? Give sketch.

*Answer.*—



The most important feature in the construction of a *Davy* Lamp is its wire gauze. Flame is gaseous matter, heated so intensely as to become luminous; and Sir Humphrey Davy found that this degree of heat is greater than that of solid bodies, flame being gas at white heat, whose temperature is about 3,640 degrees Fahr. The metals are rapid conductors of heat, therefore, when the flame comes in contact with the woven wire gauze its temperature is so reduced by the conducting power of the wire to chill or cool it, that the gas passes freely through the meshes of the wire gauze, which gauze usually consists of 28 parallel wires to the inch, or 784 meshes to the square inch. The gas will burn inside the gauze without passing through it to an outside explosive mixture, unless it be propelled through the gauze by too rapid a current of air.

Experiments prove that the common *Davy* Lamp becomes insecure in an air current having a velocity of six feet per second, or even in an air current of three feet per second, if the lamp was kept in the test for a sufficient length of time.

BENJAMIN NIGHTINGALE,
Ryhill,
Near Wakefield.

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*Question* 2. (E.)—Give examples of the use of wedging in breaking coal and rock, and show how far it is possible to substitute it for blasting with gunpowder.

*Answer.*—Wedges are used in mines to force off pieces of coal or stone where blasting is undesirable. They may be applied by driving them into a parting or joint, or into a borehole. There are also mechanical substitutes for blasting in fiery mines, such as Wedge and Feather. This consists of three iron wedges. To use them a borehole is drilled in the coal or stone to be operated upon, and two of the wedges are placed in it with the thin ends outwards; then the third wedge is driven between them.

Patent Multiple Wedge.—This consists of five parts which are applied as follows:—A hole is drilled of the required size and length, and two wedges, one above the other, are placed in the hole with the thin edge outwards; a pair of wedges with the thin edge inwards are then driven between the two first; then the fifth is inserted between the latter and driven up with a heavy hammer. This exerts a great pressure in the borehole on the coal or stone. There are many more types of wedging machines, such as *Burnett* Roller Wedge, *Lancaster's* Coal Wedge, Emperor Mining Wedge, and the Compressed Lime Cartridge. It is possible to substitute it for blasting with gunpowder, as far as the conditions of the material to be operated on will allow, as from the numerous accidents resulting from blasting operations, the damage done to the roof of the mine, and the probable release of firedamp by the shock of the explosion, and the mingling of the deleterious gases evolved from the combustion of the explosive with the atmosphere of the mine. These numerous mechanical devices have been invented for the purpose of avoiding all these dangers.

MATTHEW MOURLEY,
Rock Terrace,
Soothill Lane,
Batley, Yorks.

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*Question* 3. (E.)—Describe briefly the main-and-tail rope system of haulage.

*Answer.*—The main-and-tail rope system of haulage has the great advantage of being applicable to almost any condition of road, a single line of rails only being required. It is much better applied where roads are straight, and have regular gradients. It gives great facilities for working branch roads. The engine for working this system must have two drums—one for the main rope and the other for the tail rope—each drum being on a separate shaft and connected by spur gearing to the engine shaft, and is put in and out of gear by levers. The length of the rope required will be three times the length of the

plane, the tail rope being long enough to reach from the front end of a train or set of empty tubs standing at the out-bye end of the plane to the in-bye end, where it is passed round a large pulley, and reaches back along the plane to the drum of the engine. As the set or train of empties is drawn in, the tail rope is wound on to its drum, and the main rope is run off the other drum which is at the time out of gear. After changing the full for the empty train, the tail-rope drum is thrown out of gear and the main-rope into gear; the engine is reversed, and the full train drawn out, to which is attached the tail rope ready for the next empty set. The ropes are carried on rollers or pullies, at intervals of about eight or ten yards apart. The branches worked off the main road have pullies placed at the end of them round which a rope passes, its two ends reaching out to the main road, which are generally called "off-takes." There are different ways of making the dis-connection at the branch end. A wheel is fixed near the roof or under the rails, and one end of the branch rope is brought round this wheel. When the train is to be sent into the branch road the ropes have to be changed at the "off-takes," and there is generally a winch placed there to pull the branch ropes properly into place. The change is quickly effected by means of shackle joints on both the main and tail ropes. From 30 to 60 tubs form a train for the main-and-tail rope system, the connection between the train and the ropes being made by some form of knock-off link, so as to be easily dis-connected, and the set allowed to run in the shaft siding.

GEORGE BELL,
Shotton Colliery, *via* Castle Eden, Durham.

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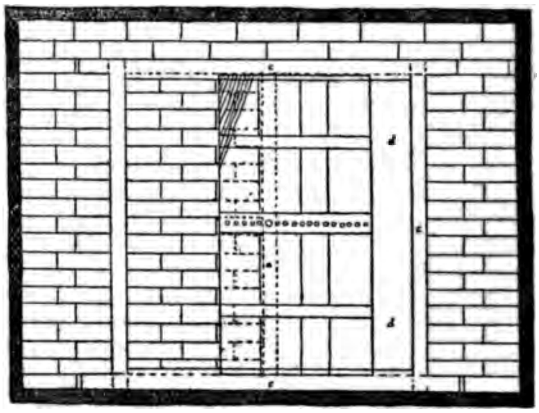
*Question* 4. (A.)—A block of coal is 1 acre, 2 roods, 10 perches (Statute measure) in area, and is four feet three inches in thickness, What weight of coal is there in the block, reckoning 18 cwt. per cubic yard?

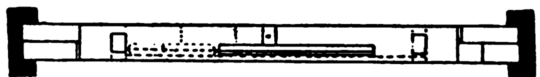
*Answer.*—A block of coal 1 acre, 2 roods, 10 perches (Statute measure) in area = 7562·5 square yards × 9 = 68062·5 square feet. Then 68062·5 × 4·25 = 289266·625 cubic feet of coal. Therefore, $\frac{289266 \cdot 625}{27} =$ 10713·541 cubic yards of coal. Therefore, $\frac{10713 \cdot 541 \times 18}{20} = 9462 \cdot 1869$ tons of coal, or 9642 tons, 2 cwt., 3 qrs. of coal nearly.

JAMES BURROWS,
103, Chapel Street, Dalton-in-Furness.

*Question* 5. (A.)—Draw and describe a permanent regulating door.



— ELEVATION —



— PLAN. —

*Answer.*—The accompanying sketch shows a permanent regulating door in plan and elevation, the principle of which is very easily understood. Four pieces of strong timber are fitted into each other as shewn in elevation (marked cccc), and when finished and erected the space enclosed is about four feet broad by four feet high inside. This is divided into two compartments by the upright which is provided in its centre with a hole where a nut is inserted, and serves for the purpose of securing the door (which is only half the width of the regulator) at any desired position, according to the necessary amount of ventilation required in any particular district. The door, as shewn, is provided with holes bored clean through it at intervals of an inch or one-and-a-half inches, and a bolt made purposely to fit the nut fixed in the upright (a), is passed through any one of them, and screwed tight into the upright by means of a regulator key, which in turn is made to fit the bolt. Thereby the door can be fixed at any desired position, and when it is required to be moved, closed or opened, all that is done is to unscrew the bolt, draw it out, and by taking hold of the side of the door or any of the holes it can be moved to and fro in the groove made in the top and bottom, and marked b in plan. According to scale, the

regulator is set about seven inches open in the above sketch and is marked (d), through which space the air, after having served a district of workings, passes on its way to the up-cast shaft. It will be observed that only half of the frame is open and available for regulation, while the other half is built up with bricks, over the face of which a covering of lime is placed. Further, the sides, top and bottom of the frame are also built with bricks and faced with lime or cement, if the roof is bad, so as to make the arrangement, as far as practicable, air-tight, except where the air is intended to pass through. If sufficient ventilation is not obtained with the regulator half open, all that is required is to take down the bricks inside of frame, shift upright (a) nearer the side, take a deal off the door and proceed as before.

JNO. LAVERICK,
Eppleton Colliery,
Hetton-le-Hole, R.S.O

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*Question* 6. (A.)—What course would you try when the roof of a roadway is very destructive of timber, and almost impossible to support?

*Answer.*—The course I would try would depend very much upon surrounding conditions. If the road to be secured were a horse road and had to go for a considerable length say 500 yards, I would use steel bars or ordinary old railway metals, supported by good props, say nine inches diameter. Over the steel bars battens nine inches by three inches should be laid over them, parallel with the road. Battens to be six feet long. This method is practised at a colliery in Westhoughton successfully.

Should the road to be secured only have to go for a distance of 100 yards or thereabouts, and would have to stand for a good many years, I would have a brick wall, nine inches thick, built along each side of the road. The steel rails or girders to rest on the walls, and covered with batens or old boiler plating. This method I have seen practised at a colliery near Chorley where the roof above was of a very crumbling nature.

If the road I had to secure had a big side weight, and the bottom lifted very much, and if it was near the pit bottom (say a pit-bottom siding), I would build a horse-shoe or barrel arch. The tops and sides of the arch to be from two to three feet thick, and the bottom portion nine inches to eighteen inches thick. This method is practised at various collieries in Lancashire with success.

WILLIAM LITTLER,
234. Woodhouse Lane,
Wigan.

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*Question* 7. (H.)—Give a tabulated summary of the coalfields of the British Isles.

P.S.—The award for this question will be increased to 2s. 6d.

*ANSWER.*—TABULATED SUMMARY OF THE GREAT COALFIELDS OF THE BRITISH ISLES.

| NAME. | LENGTH. | BREADTH. | AREA EXPOSED. | AREA UNEXPOSED. |
|---|---|---|---|---|
| Notts, Derbyshire, and Yorkshire ... | From North to South 60 mls. | From 5 to 20 miles | 760 sq. mls. | 900 square miles under Permian and Triassic Rocks |
| Durham and Northumberland | From the mouth of Coquet to Staindrop, 50 miles | Its greatest width is 20 miles | 460 sq. mls. | Beneath the Permian, 25 square miles; beneath the sea, 111 square miles. Total, 796 square miles |
| Cumberland ... | North, from Maryport, to South, St. Bees Head, 20 mls. | Greatest width, 5 miles | 25 sq. miles | |
| Bristol and Somerset ... | 26 miles | This coalfield has a triangular form with a base 7 m. long | About 150 sq. miles | The greater part overlaid with Permian and Triassic Rocks |

*COALFIELDS OF THE BRITISH ISLES.*—CONTINUED.

| NAME. | LENGTH. | BREADTH. | AREA EXPOSED. | AREA UNEXPOSED. |
|---|---|---|---|---|
| Dean Forest ... | 7 miles | From 5 to 6 m. | 34 sq. miles | |
| Shrewsbury ... | 18 miles | 1 mile | About 16 mls. | |
| South Staffordshire ... | 21 miles | About 7 mls. | 93 sq. miles | |
| North Staffordshire ... | 11 miles from Congleton on the N. to Longden on the S.W. | About 10 miles | 75 sq. miles | Area unknown, but overlaid to the S. by Permian Rocks. |
| South Lancashire ... | W. to E. 32 miles | N. to S., 6 miles | 217 sq. miles | Area unknown |
| Warwickshire... | 15 miles | Broadest part 5 miles | 30 sq. miles | 90 miles under Permian Rocks |
| Leicestershire... | 16 or 17 miles | Gr'test width 14 or 15 mls. | 30 sq. miles | 90 square miles under Permian Rocks |

WELSH COALFIELDS.

| | | | | |
|---|---|---|---|---|
| South Wales ... | 73 miles | N. to S. 16 miles | 906 sq. miles | |
| Denbighshire... | 18 miles | 4 miles at Wrexham | 47 sq. miles | |
| Flintshire, N. Wales ... | 15 miles | From 1 to 5 miles | 35 sq. miles | |

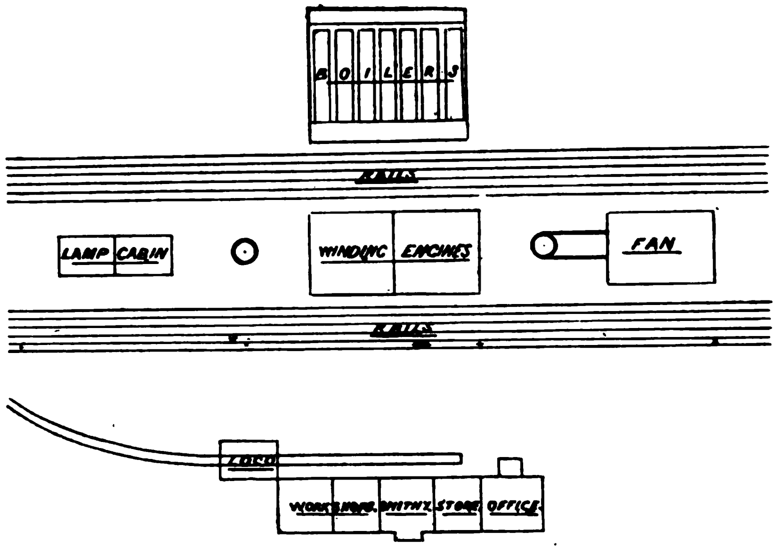
SCOTCH COALFIELDS.

| NAME. | LENGTH. | BREADTH. | AREA EXPOSED. | AREA UNEXPOSED. |
|---|---|---|---|---|
| Clyde Basin ... | N. to S., 32 miles | 34 miles E. to W. | | |
| Ayrshire ... | 33 miles N.-W. and S.-E. | From 8 to 25 miles | | |
| Midlothian and Haddington... | $22\frac{1}{2}$ miles N.-E. and S.-W. | Average, about 8 m. | 44 sq. miles | |
| Clackmannan... | Greatest length E. & W. $14\frac{1}{2}$ miles | 3 to 7 miles | | |
| Lesmahago ... | N. & S., 7 miles | E. & W. $7\frac{1}{2}$ m. | | |

ISAAC SMITH, 13, Hardwick Place, Hunslet Carr, Leeds.

*Question* 8. (H.)—Give a surface plan shewing offices, boilers, engine houses, etc., of an independent colliery.

*Answer.*—The accompanying sketch shows the surface arrangement of an independent colliery; many things, however, would depend upon the locality. In the sketch, I have shewn three sets of rails on each side of the pit parallel to each other, they are, however, gradually curved in on each side, at a suitable distance from the pit, so as to form only one line. A short distance from where the lines meet on the side which proceeds to main railway, the weighing machine and cabin are situated, on the other side of the cabin a cart weighing




machine may be fixed, The boilers are situated opposite the two engine houses on the other side of the line of rails; and the steam may be conducted to the engine houses in pipes fixed at a suitable height above the rails to allow the wagons to pass under.

In case it be decided to have the hauling engine house on the surface, it may be placed between the engine house and the pit, or on one side of the rails.

(Will the sender of the above please forward his name.—Editor.

*Question* 9. (M.)—Give a description of the manner in which you would ventilate a mine, giving reasons for the fixing of various arrangements to accomplish same, and their position, etc.

*Answer.*—In making arrangements for ventilating a *new* mine I should proceed as follows:—

I shonld use a *Marsden's* Patent Double-inlet Fan, placed in such a position, and under such conditions as would tend to ensure its being uninjured by an explosion. (C.M.R.A., Gen. Rule 3.) I should conduct the air through the lower side places first, thus taking advantage of ascentional ventilation. On commencing to make in-take and return airways I would have them of a fairly large area, say nine feet wide by six feet high, and would see that they were kept in good condition. I would have as many splits as were practicable, commencing with them as near the dowhcast as possible and ending them as near the upcast as possible. In doing this I would reduce the extent of a possible explosion, as well as reduce the velocity in the returns, which is often dangerously high. I would have as few air-crossings, doors, regulators and cloths as possible. The air-crossings which I was obliged to have I would have so constructed as to resist the force of an explosion by having them "blown" through the solid rock, above or below the road I wished to cross. What doors I was forced to have I would try and keep out of haulage, and main haulage roads especially. The regulators (which would be as few as possible) I would have placed in the return air-way so as to be out of the way, always bearing in mind that "a sufficient supply of air must be constantly kept in circulation to dilute and render harmless all gases, and to have the roads and places fit to work and travel therein.

WILL. ATHERTON,
236, Woodhouse Lane,
Wigan.

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*Question* 10. (M.)—If, whilst making a survey, you lost the angling screw immediately after taking a true bearing with the needle, and it was not possible to remove the iron in the remaining part of the survey, how would you proceed?

*Answer.*—In the presence of a large quantity of iron it is usual to obtain one true bearing, and then proceed with the fast needle. The angling screw being lost however, this is of

course impossible. The only way out of the difficulty then is to take a foresight and a backsight at each set, and work out the correct bearings afterwards. The following survey was done in the above way, a true bearing being obtained at B, and nowhere else. It is a tie survey.

| No. | Back Bearing | Fore Bearing | Correct Bearing | Fur. | Ft. | In. |
|---|---|---|---|---|---|---|
| A | ... | 3° 36′ | 3° 36′ | 6 | 4 | 1 |
| B | 3° 36′ | 1° 36′ | 1° 36′ | 3 | 4 | 10½ |
| C | 5° 57′ | 327° 44′ | 323° 53′ | 5 | 3 | 5½ |
| D | 319° 15′ | 224° 53′ | 229° 31′ | 6 | 1 | 7½ |
| E | 202° 57′ | 156° 44′ | 183° 18′ | 6 | 0 | 1½ |
| F | 167° 48′ | 165° 03′ | 180° 33′ | 4 | 1 | 8 |
| G | 166° 15′ | 79° 48′ | 94° 06′ | 8 | 0 | 3 |
| H | 79° 34′ | 349°.04′ | 3° 36′ | 0 | 0 | 0 |

The instrument was set up at B where there was no attraction, and a backsight taken to A, and this being correct was also entered as a foresight to A. A foresight to C was then taken and the instrument moved to C, where a backsight to C was obtained (5° 27′). This differed from the foresight taken from B (1° 36′) by 5° 27′ — 1° 36′ = 3·51′, so the foresight from C to D (327° 44′) will also be 3·51′,—too much, therefore 327° 44′ — 3° 51′ = 323° 53′ which is the correct bearing of CD. The instrument is next moved to D where the backsight to C (319° 15′) is 4° 38′ too small, so the foresight to E is also 4° 38′ too small, = 224° 53′ + 4° 38′ = 229·31 correct bearing of DE. The instrument is again moved to E, when the backsight to D (202° 57′) is 26° 74′ too small; the foresight to F is also 26° 34′ too small. Therefore correct bearing of EF is 156° 44′ + 26·34 = 183° 18′. The back-bearing from F to E is 167° 48′ which is 15° 30′ too small, therefore the correct bearing of FG is not 165° 03′ but 165° 03′ + 15° 30′ = 180·33. The back bearing of GF is 166° 15′ instead of 180° 33′, therefore the forebearing of GH must be 180° 33′ — 166·15, or 14° 18′ too small; the right bearing is therefore 79° 48′ + 14° 18′, or 94° 06′. The legs are finally moved to H, and the backbearing 79° 34′ is 14° 32′ too small; therefore the forebearing 349° 04′ is also 14° 32′ too small. Correct bearing is therefore 349·04 + 14·32 = 363° 36′ or 3° 36′, which is identical with the first bearing, H being A. Thus in a tie survey the surveyor is enabled to check the accuracy of his work.

THOMAS MORDY,
Cross Lanes,
Hetton-le-Hole, R.S.O.

# PRIZE COMPETITION.

## QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by February 3rd, 1894.

*Question* 1. (E.)—Describe, with sketch, a good method of guiding the hoppit or kibble (in a sinking shaft) when nearing the surface.

*Question* 2. (E.)—How would you test for gas in a mine with an ordinary safety lamp.

*Question* 3. (E.)—What is meant by proving a coalfield?

*Question* 4. (A.)—How would you proceed to timber a shaft with wood lining, giving a sketch of same?

*Question* 5. (A.)—A place used as a sump or lodge room is 45 yards long, and averages 7 feet wide by 6 feet high. How many gallons of water does it contain, allowing 6¼ gallons to each cubic foot?

*Question* 6. (A.)—Describe, with sketch, the method of walling a shaft through ordinary strata.

*Question* 7. (H.)—Describe, with details, some variety of safety catches, and state the conditions necessary to ensure safety with such contrivances.

*Question* 8. (H.)—In what way may danger arise from coal dust in mines? What method would you employ for counteracting the danger?

*Question* 9. (M.)—Describe, with sketch, the method of working coal by the "Longwall" system, giving the distance apart of roads, and under what circumstances it is most advantageous.

*Question* 10. (M.)—What are the benefits derived by splitting the air? Where should the splits be made, and where should they join again in order to reap the greatest advantage? Give a sketch to illustrate the principle.

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MINING

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o 6. Vol. II. SATURDAY, FEBRUARY 10, 1894. FORTNIGHTLY. ONE PENNY.

CONTENTS.



## EASY LESSONS ON MINE SURVEYING

(This article has beeu unavoidably held over through lack of space.—Editor.)

## HAULAGE.

### CHAPTER VII.

*Continued from last Number.*

### TAIL-ROPE SYSTEM.

THE circumstances under which this method of haulage is adopted are when the gradient in-bye is insufficient to make the tubs self-acting, or when the gradient out-bye is insufficient to allow the empty tubs to draw the rope from a direct hauling engine after them. Its most advantageous feature is that it can be adopted under almost any conditions. It only requires a single road, and it will act perfectly in crooked roads or those with varying gradients. Another important advantage is that any number of branch roads may be worked equally well.

In case the gradient of the road is in favour of the load or full tubs, that is, inclined towards the shaft, but is only sufficient to allow the full tubs to draw the rope after them and not haul the empty tubs back, the system known as the single-tail rope may be adopted.

The single-tail rope is really a modification of the direct haulage system, but instead of the engine being used to haul the full tubs, it is used to haul the empty ones. To accomplish this a rope is carried from the engine near the shaft, on suitable pulleys, along the side or top of the haulage road, passes round a return wheel at the end of the haulage road and is fastened to the gang of full tubs about to descend. The drum of the engine is thrown out of gear, and the descending tubs draw the rope along. It will thus be seen that the length of rope necessary will be twice the length of the road. The end of the rope having been drawn to the station where the empty tubs are awaiting, it is changed from the full tubs to the empty gang, the drum is put into gear, and the empty tubs hauled to the workings. An engine fixed at the end of the road, and hauling direct, could be applied

to accomplish this same end, but there would be great loss of power in conducting the steam or compressed air to such a distance; besides, it is far more convenient to have the engine near the shaft, or even at the surface.

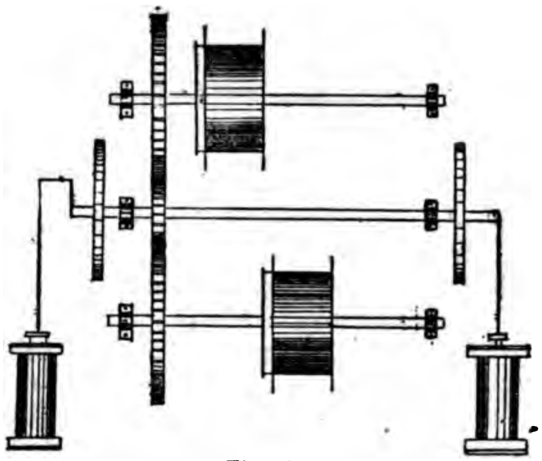


Fig. 1.

We will next consider the tail-rope system proper, or more strictly, the main-and-tail rope. Either this or the endless system is used when the circumstances necessary to the methods of haulage previously described are wanting.

In the main-and-tail rope system two drums are necessary: one for the main rope, and the other for the tail rope. The drums are worked on the second motion, and may be placed upon one shaft or two, but in either case both drums must be capable of being thrown out of gear. The most common arrangement is to have the *two drums working* upon different shafts (Fig. 1), the crank shaft being placed between, and the connection made by suitable clutch gear. The front drum is used for the main-rope, and the back one for the tail-rope. The tail-rope must be twice the length of the road, and the main rope once, and as the tail-rope has not as heavy work to perform as the main-rope it is made lighter. The tail-rope (Fig. 2) is carried on pulleys along the side of the road, as previously described, and passes round a sheave or return wheel at the in-bye end of the plane. It is then attached to the last tub of the full gang, and the main-rope to the front tub. The tail-rope is thrown out of gear, but the brake is gently applied to prevent the rope from becoming slack, and the main-rope drum being in connection with the engine hauls the full tubs and also the tail-rope out-bye. The journey being made the tail-rope is connected to the in-bye end of a train of empties, and the main-rope to the other. The main-rope drum is thrown out of gear and the other put in connection with the engine. The tail-rope then hauls the empty tubs in-bye together with the main-rope, and the same operations are again gone through. The number of tubs to a train is usually from 30 to 60, and a very great speed may be attained. The writer has seen this system of haulage in use where the customary speed was from 15 to 20 miles an hour, but this was under the most advantageous circum-

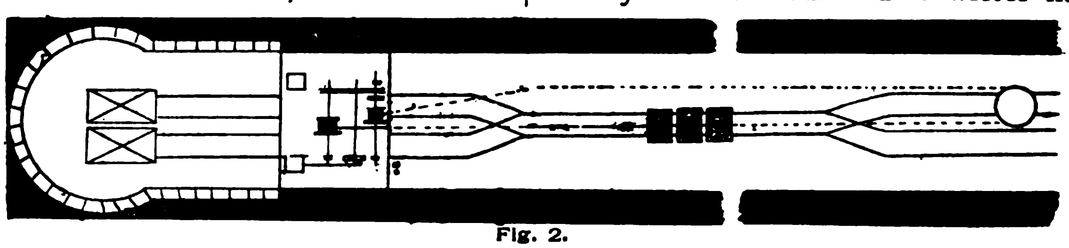
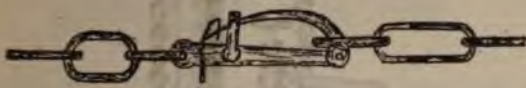


Fig. 2.

Fig. 3.



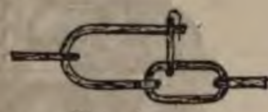


Fig. 4.

stances—a long, straight, level and well-kept road without branches. The diameter of the wheels of the tubs was, however, only 9 inches, and the gauge of the road 2 feet.

A more secure connection than the ordinary hook is necessary between the train of tubs and the rope when the tubs are drawn at high speeds, and for self-acting inclines, direct haulage, and the tail-rope system, one of the two knock-off links illustrated by Figs. 3 and 4 are used. As will be seen in both cases a movable link is turned over the hook after its connection to the link of the tub, and is held in position by a cotter.

CORRECTION—The arrows on the sketch (Fig. 1) which appeared in last issue illustrating the Direct Haulage system with two ropes are pointing in the wrong direction.—Editor.

(*To be continued.*)

## PUMPING.

### THE AQUA THRUSTER.

IN this pump the water is raised by the steam acting directly on its surface. It is, in fact, a remodelling of the pumping engine constructed by THOMAS SAVERY in 1698, which was the first application of steam to perform useful work. Savery's engine was so imperfectly constucted however, that the design was entirely abandoned in favour of interposing other working parts between the steam and the water, until recent years.

As will be seen by the illustration (Fig. 1) which shows the internal

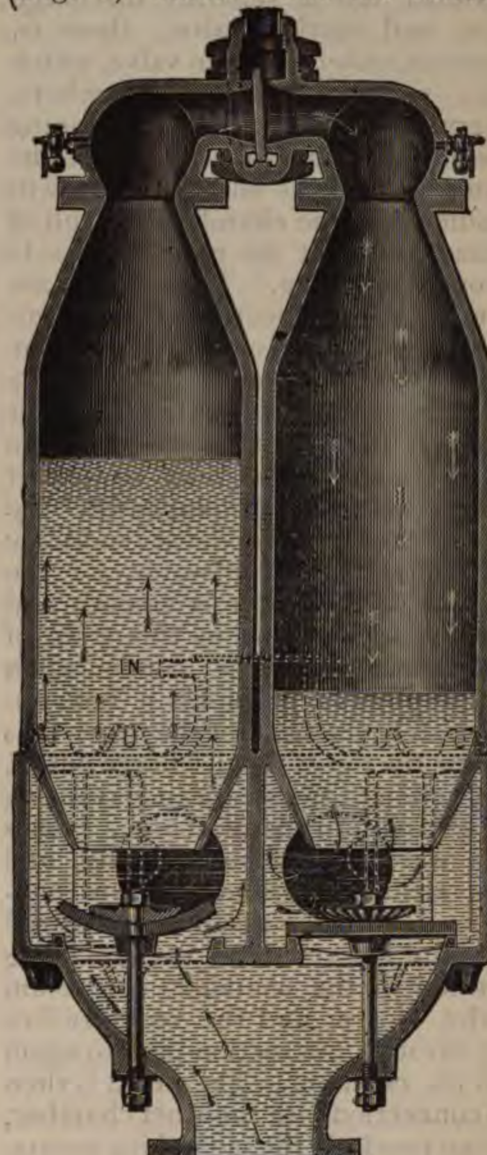
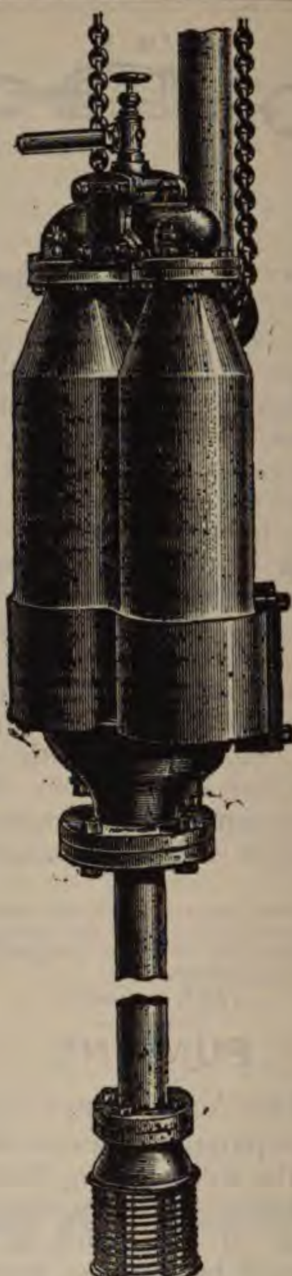




Fig. I.

arrangement, the Aqua Thruster consists of two bottle-shaped chambers capable of holding a large quantity of water, connected by suitable channels to the steam pipe at the top, and to the suction pipe at the bottom. The position of the discharge orifices is shown by the two dark circles, the

two pipes being afterwards connected together to form the main. Each chamber has a separate discharge pipe, and suction valve; there is, however, only one steam valve, which does service for both chambers, alternately shutting and opening them. The manner in which the pump works is as follows:—We will assume that the chambers are full of water, and that the right-hand side is open to steam. Then the steam coming in the direction of the downward arrows, acts directly on the surface of the water, opening the discharge valve, and forcing the water through the discharge pipe into the rising main. Contrary to what would naturally be expected, the steam does not condense suddenly on contact with the water, for the surface of the water is smooth and steady, and so long as this state of conditions last, the condensation takes place very slowly; but immediately the level of the water falls below the top of the discharge outlet, the action of the steam endeavouring to escape into the discharge, causes the water to bubble violently, and the steam is instantaneously condensed, with the result that a partial vacuum is formed. A vacuum being formed in the chamber, the steam valve closes, and the water rushes up through the suction pipe to again fill the chamber. The steam is then in connection with the other chamber, when precisely the same thing occurs. The connections with the steam, discharge and suction pipe, and the method of suspending the pump are clearly shewn by Fig. 2. The height to which it will raise water is about 100 feet, or two or more may be coupled together to raise the water to a greater height. They will work *with exhaust* steam, or up to 100 lbs.



pressure, and as this pump has neither pistons nor working parts, there is nothing likely to get out of order, and no oiling nor packing is required. It works as well when suspended by chains or ropes as on a solid foundation, and it will pump muddy water quite as well as clear.

## [AMINATION QUESTIONS,

**With Answers,**

IRST-CLASS CERTIFICATED MANAGER.

*Commenced in No. 5, Vol. II.*

ollowing questions for the Examination
lidates for Certificates of Competency
t in the Manchester District, Decem-
)2.

### oal Mines Regulation Act, 1887, and the Special Rules.

;TION 1.—What books does the Act
to be kept?

/ER.—Register of all persons whose
f employment are regulated. General
record of ventilation. General Rule 4,
ion as to condition of the ventilation
neral safety of the mine. General
, machinery inspection, both above
low ground; also weekly inspection
s. General Rule 7, withdrawal of men
of danger. General Rule 38, periodical
ion of mine by workmen. Special
;7, report for sinking.

;TION 2.—Enumerate all the provisions
\ct with regard to plans.

VER.—An accurate plan of the mine
: kept in the office of the mine, shewing
:e of the workings up to a date not
ıan three months previously, and the
direction and rate of dip of the strata,
r with a section of the strata sunk
ı. If this is not reasonably practicable,
ment of the depth of shaft with a
of seam. An inspector, under this
ıy request the owner, agent or manager
nine to mark on such plan and section
n state of the workings of the mine,
: inspector may be entitled to examine
ı and section, and, for official purposes
ıake a copy of any part thereof. Also
ırate plan of every abandoned mine or
howing the boundaries of the workings
mine or seam up to the time of the
nment, and also shewing the position
/orkings with regard to the surfaces, is
ent to the Secretary of State within
nonths after such abandonment, to-
with a section of the strata sunk
ı. If this is not reasonably practicable,
nent of depth of shaft with a section
seam. The general direction and rate of dip must be given in either case. Every such plan must be on a scale of not less than twenty-five inches to the mile, or on the same scale as the plan used at the mine.

QUESTION 3.—What are the requirements of the Act as to engine and boiler houses underground?

ANSWER.—There shall be at least two proper travelling ways into every steam-engine room and boiler gallery.—(General Rule 15.)

QUESTION 4.—What are the provisions of the Act with respect to the dimensions of road?

ANSWER.—Every road on which horses or other draught animal are used underground, shall be of sufficient dimensions to allow the horse or other animal to pass without rubbing against the roof or timbering.—(General Rule 17.) Also, the communications between shafts must not be less than four feet wide and three feet high, and communications between such shafts or outlets made after 1st January, 1888, must not be less than four feet high.

### Practical Working of Collieries.

QUESTION 1.—What pillar of coal would you leave for the protection of a pumping shaft in a mine 5 feet 6 inches in thickness, with a dip or inclination of 1 in 3, the depth at the shaft being 450 yards?

ANSWER.—I should leave a pillar of 200 yards square.

QUESTION 2.—Make a sketch of a furnace for an extensive mine, marking the dimensions. Under what conditions does danger attend the use of a furnace in a fiery mine, and how would you avoid them?

ANSWER.—(1) The danger of the return air coming in contact with the furnace when the mine gives off such a quantity of gas at any time as to render it an explosive mixture is very great. To avoid this I would feed the furnace with fresh air, and conduct the return through a dumb-drift so that the flame given off from the furnace could not possibly come in contact with the return.

(2) There is always the danger attending the use of a furnace in any mine of the coal and metal surrounding it getting on fire. To avoid this I would build the furnace as per sketch (Fig 1). Outer case or arch: walls 18

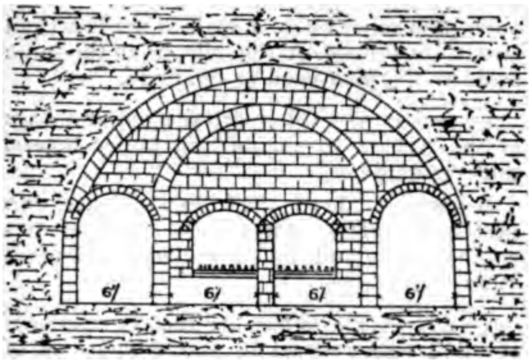



Fig. 1.

inches thick, and behind the arch, pack with 18 inches of fine sand. Inside this the furnace and flues are built, leaving a space on each side of 2 feet 6 inches between flue and outer wall, so that they can be ventilated and examined at any time. Also, underneath the whole area of fire-bars I would put an iron pan, 6 inches or 8 inches deep, and keep it

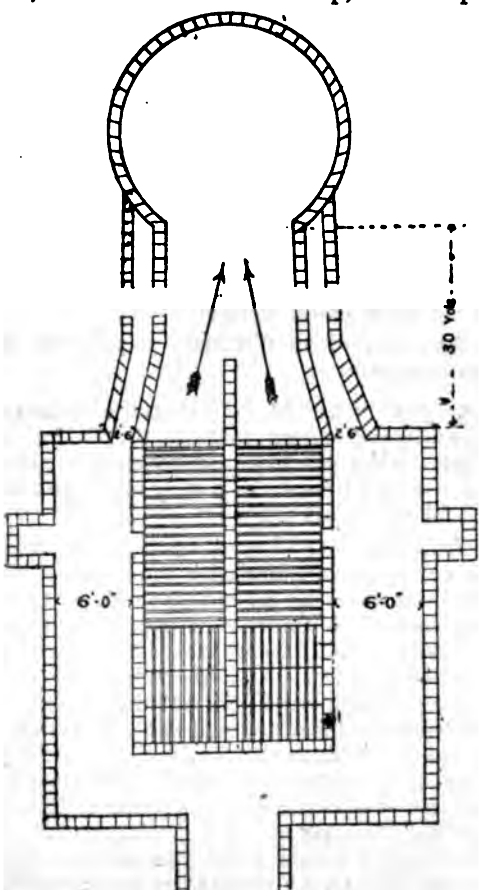



Fig. 2.

filled with water so that the ashes are easily and speedily cooled. The furnace is a double one, each 6 feet by 14 feet, one portion fired on front, the other on side (Fig 2).

For an extensive mine a large furnace is required, and as a well-constructed furnace is capable of yielding about 1000 cubic feet of air per minute for every square foot area of fire grate, we have 6 feet × 14 feet = 84 square feet area in each furnace, and 84 × 2 = 168 × 1000 = 168000 cubic feet of air per minute.

(*To be continued.*)

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## PRIZE COMPETITION.

### QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by February 17th, 1894.

*Question* 1 (E.)—How much coal might be expected to be available in an area of 150 acres of a four-foot seam, allowing one-fifth for faults and waste?

*Question* 2 (E.)—Give an account, with some illustrative details, of a vertical shaft with wire rope guides.

*Question* 3 (E.)—What minerals are usually found in stratified deposits?

*Question* 4 (A)—What observations are required in order to determine the mechanical efficiency of the method employed in ventilating a mine?

*Question* 5 (A.)—At what rate will it be necessary to work a 12-inch pump of 9 feet stroke to keep a flow of 200 gallons of water per minute, in a shaft 200 yards deep, and what approximate H. P. will be requisite?

*ion* 6 (A.)—What construction of
s best adapted to prevent breakage of
screening?

*on* 7 (H.)—When a coal seam is on
' should it be isolated to prevent the
m spreading to other parts of the
;s?

*on* 8 (H.)—Describe, with sketch, a
percussive boring machine.

*on* 9 (M.)—Describe the best kind of
or the safe and economical generation
m, at high pressure, for colliery
. Give a description of the mountings
gs necessary for safe working.

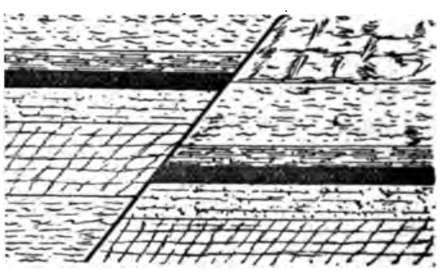
*on* 10 (M.)—Granting that a boy has
pportunity, what course do you con-
e best for him to adopt to become an
colliery manager?

## VERS TO QUESTIONS

### In No. 4, Vol. 2.

*n* 1. (E.)—What is a fault? Describe
tches an ordinary and reversed fault.

*r.*—In its simplest form, a fault is a
fracture occuring in some series of
such a manner as to interrupt their
ty, the corresponding edges of the
n each side of the fracture being
d by a distance which is spoken of as
row." Of course, faults vary greatly
mount of "throw." In some cases
ta are scarcely displaced, whilst in
nany hundreds of yards intervene
the faulted measures.



Reversed Fault.

are various kinds of faults,
figure represents a reversed fault.
t cases the lost portion (in the
oal) will be found on the side—either
lown—of the seam, the outside of
rms the greater angle with the plane of the fault, which is an ordinary fault, but sometimes, however, the strata has been so violently contorted that the edges of the fractured strata are pushed over each other, forming a reversed fault as sketch.

JOSEPH WHEATCROFT,
8, Longsight Terrace,
Kinsley Hemsworth, near Wakefield.

*Question* 2. (E.)—State the relative advantages, and the weight and dimensions of the different mining picks with which you may be acquainted.

*Answer.*—The picks I am acquainted with, and which are used generally by the miners in this district are:—(1) The ordinary pick, which as been in use for years. (2) The "Universal," a patent pick now in common use. (3) The "Acme," another patent pick which is also superseding the old ordinary pick.

The ordinary pick is now getting out of use. It has many disadvantages, amongst which are the following:—It will not bear rough usage such as straining when pulling stones, etc., as it is liable to get loose on the shaft; the part of the shaft near the blade is often burned, owing to the blade being fast on the shaft, and coming in close proximity to the fire during sharpening operations. These blades weigh from 1½ lbs to 4 lbs., the heavier blade being more generally used by the metal-men in tunnel driving, roof blowing, &c. They are from 12 to 20 inches in length. The "Universal" and the "Acme" are made with the blades loose, and both have the advantage of being capable of being sent to surface and sharpened without the shaft, consequently there being no danger of the shaft getting burned from that cause. Another advantage is that the miner only needs one shaft, no matter how many blades he may have. When a blade gets dull, or the points broken or worn, he simply replaces it with a sharp one. Of the two patents, the "Acme" and the "Universal," the latter is more in use than the former. One reason may probably be because any number of blades up to a dozen may be slipped on to one shaft, and this makes them more easy to carry to and from the working face. The shafts to these picks are of similar lengths to those of the ordinary picks. They will stand a great deal more rough usage owing to the iron collars or headings on to which the blades are slipped.

THOS. SETTLE,
234, Woodhouse Lane, Wigan.

*Question* 3. (E.)—Enumerate the precautions to be taken against accidents in drawing or winding shafts.

*Answer.*—The classes of accidents which have to be guarded against in drawing or winding shafts are:—Firstly, from overwinding; secondly, breaking of winding ropes; and thirdly, to protect the men from falling material whilst ascending or descending the shaft. Overwinding, where the cage with its human freight is carried up violently against the pulleys overhead, is to be avoided by the employment of only the most trustworthy engine drivers, the use of steam brakes, a sufficient height of pulley frame, and the use of a detaching hook. A good form of detaching hook is the one invented by Mr. Wm. Walker, Saltburn-by-the-Sea, and which is described in No. 1 of Vol 2 of this Journal. The second class of accidents is from the breakage of the rope which can only be guarded against by keeping in use the very best material, and caution in not running a rope too long, or omitting to have it frequently examined. Many ingenious contrivances have been invented for arresting the cage from descending the shaft when the rope breaks, but have not met with any extended favour, at least in this country. To protect the men from falling materials whilst ascending or descending the shaft, a cover or bonnet of sheet iron is added to the top of the cage, whilst sliding gates at the shaft top, which are lifted when the cage comes up but guard the brink of the pit when the cage is down, are safeguards against many of the accidents in connection with shafts.

W. H. HARDY,
37, Princes Street,
Eastwood, Notts.

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*Question* 4. (A.)—What are the advantages and disadvantages of rope boring?

*Answer.*—The method of boring by rope as a substitute for rods has for its birthplace the land of the Celestials—China; hence it is sometimes called the Chinese method of boring. Since its introduction it has been subjected to a highly-modified improvement by Messrs. Mather & Platt, which has given highly satisfactory results, and shown itself in many respects superior to the method of boring by rods, by the following advantages:—(1) There is no screwing and unscrewing of rods when they are required to be raised and lowered, which is a tremendous loss of time in boring by rods; the rope is wound round a horned drum, and can be raised in a very short space of time. (2) The weight of the rope is considerably less than an equal length of rods, hence there is less weight to be dealt with. (3) No possibility of breaking the connection, as in rod-boring every screw is a weak point when considerable depth is attained. (4) Tools can be changed rapidly. (5) Sludger or shell pump can be raised and lowered at the rapidity of 500 feet per minute in Mather & Platt's system showing how rapidly it can be cleared of the broken debris. (6) Very little manual labour is required, as there are no heavy rods to lift and unscrew. One or two labourers will suffice. (7) A great depth can be attained. The greater depth gives greater power to the cutting tool, and the stroke of the engine should be lessened on attaining a great depth. (8) Moderate cost of boring.

Like many other inventions, it also has its disadvantages, which may be enumerated as follows:—(1) Owing to the elasticity of the rope the hole is very apt to deviate from the vertical plane, and most especially in highly-inclined strata and strata of variable hardness. In this event the hole has sometimes to be tightly plugged up again, and boring recommenced. (2) Great fear of the vertical bearing piston breaking, as the whole weight (on the up-stroke) of the rope and cutting tool is upon it; hence this piston-rod should be made extremely heavy, not less than seven inches thick. It will thus be seen that it has many advantages, and few drawbacks.

GEO. A. HAWES,
Holy Trinity Terrace,
Murton Colliery,
Co. Durham.

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*Question* 5. (A.)—State the relative advantages of wooden and iron tubs.

*Answer.*—Wood tubs or trams are more universally used than iron tubs, and claim the following advantages:—(1) Their first cost is a great deal less than iron ones. (2) They are considerably lighter than iron ones in weight, and thus take extra strain from manual labour, horse labour, and engine power in haulage. When the tubs are displaced from the rails they are replaced with considerably less difficulty than iron tubs. (3) Wood tubs, when damaged, can be easily put right again, with perhaps the addition of a new deal or two. (4) Wooden

› not set up the friction which iron
› in coming in contact with steel curve
I have seen a whole curve lighted up
e friction on the check-rails.
tubs claim only one advantage over
ı tubs, inasmuch as in wet seams they
affected by the water as wooden ones
Wooden ones are liable to rot in a
me, but with iron ones only a little
on is experienced. On the whole,
ı tubs are much to be preferred to iron
specially in the coal mine.

GEO. A. HAWES,
Holy Trinity Terrace,
Murton Colliery,
Co. Durham.

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*ion* 6. (A.)—What different kinds of
are used in mining, and state their
e efficiency?

*ver.*—The different kinds of ropes used
nd ropes and flat ropes, either kind
made of iron, steel, or hemp. The
steel wire ropes are generally preferred
nding and hauling purposes. To
the same work iron ropes would have
much heavier than steel, and would
higher cost. The flat ropes are more
ive and much heavier than round ropes
he same work. The hemp ropes are
sed for temporary purposes on crabs,
r for shallow sinkings. The safety
f round ropes may be taken from ⅙th
of the breaking load. The working
f flat ropes may be taken from ⅛th
ı of the breaking load. To find the
of ropes:—

weight in cwts. of 450 fathoms for hemp ropes.

weight in cwts. of 128 fathoms for wire ropes.

extra weight of flat ropes, per fathom,
pared with round ropes of the same
h is as 5 to 4.
ngth of round ropes:—
$W$ = breaking or proof load in tons.
= circumference of the rope in inches.

p rope: $W = 0{\cdot}25C^2 \therefore C = \sqrt{\frac{W}{0{\cdot}25}}$

ire rope: $W = 1{\cdot}50C^2 \therefore C = \sqrt{\frac{W}{1{\cdot}50}}$

vire rope: $W = 3{\cdot}00C^2 \therefore C = \sqrt{\frac{W}{3{\cdot}00}}$

vanised wire ropes are sometimes used
and up-cast shafts.

GEORGE DAYKIN,
24, High Gurney Villa,
Bishop Auckland.

*Question* 7. (H.)—State what conditions would guide you as to the size of a proposed shaft. Give an example.

*Answer.*—There are a great variety of points to be considered before determining on the size of a shaft; without which consideration a great deal of foolish expenditure may be the result. The shafts may be much larger than is necessary, or, on the other hand, they may be too small, and the output and general working and success of the mine crippled. The conditions which would guide me as to the size, &c., of a shaft may be enumerated as follows:—(1) The area to be wrought. (2) The thickness and number of seams. (3) The output required, in order that the royalty may yield a dividend. (4) The probable quantity of water to be pumped. (5) The terms on which the royalty is secured and the probability of adjoining royalties being secured on favourable terms. Suppose the royalty to be worked is of a considerable extent, say not less than a square mile, and with seams such as we have in the Wigan district, and all the other conditions being favourable, I would arrange for an output of not less than 1000 tons per day of eight hours.

To meet the above requirements I would have the shaft 18 feet in diameter (provided that not more than 500 gallons per minute of water had to be dealt with) so as to allow for a cage of a sufficient size to haul four tons each lift, and also to provide passing room at meetings. The circular form of shaft is the strongest and cheapest, and is the form most generally used, though an elliptical shaft is better suited for putting in pumps, &c. The slight inconvenienee of fixing pumps in a circular shaft, however, does not outweigh its advantages, and this would be the form I would adopt in any case.

WILL. LITTLER,
234, Woodhouse Lane,
Wigan.

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*Question* 8. (H.)—What are the constituents of fire-damp? What is its specific gravity, where and when would you expect to find it, and how is it found?

*Answer.*—Firedamp is known by other names, such as light carburetted hydrogen, marsh gas, and methyl-hydride. Its chemical symbol is $CH_4$, indicating that it consists of one part of carbon combined with two parts of hydrogen; or, the proper composition: carbon 75 per cent., hydrogen 25 per cent., equals 100 per cent. Its specific gravity is

·559, air being taken as unity. Consequently it floats or stratifies in air, and is nearly always found next the roof, or in the higher or rise points of the workings of a mine. This gas is given or oozes out of the coal, and from cracks and fissures of the roof and the floor; also from between the cleats or cleavages of the coal seams, and is found to be given out very freely and in large quantities in the neighbourhood of faults and dykes. More of this gas is found in deep mines than in shallow ones. It exists in the various coal seams at a high pressure, this pressure increasing with the depth; the deeper the mine, the less chance has it of making its escape to the surface. When 1% of fire-damp is intermixed with 30% of air, the presence of the gas is shown by a blue halo or "cap" surmounting the flame of a safety lamp, and when a mixture of 1% gas and 15% of air is ignited by a naked light the result is a violent explosion. When the mixture consists of 1% of gas to 10% of air, the most severe explosion is produced, as there is then sufficient oxygen present in the air to produce perfect combustion of the gas. When the mixture reaches the proportions of 1% of gas to 5% of air, it no longer becomes explosive, but extinguishes lights. This gas is dangerous to inhale as it produces death by suffocation. Like all other gases, fire-damp is subject to BOYLE's law, and in the event of a reduced atmospheric pressure this gas is given off in considerable quantities from the goafs, and and fissures in the roof and floor of the coal seams. At this time the fireman or deputy needs to be very minute and cautious in making his examinations. Its presence at any place may be detected by the effect it has upon the flame of the safety lamp. When present in small quantities it causes the flame of the lamp to flicker a little, vertically; when more is present the flame is enlarged and elongated, and frequently a blue halo or cap (as mentioned above) surmounts the flame. When mixed with carbonic oxide gas, CO, the blue cap is tinged with brown, and the flame is thickened and elongated a little more than usual. To detect the appearance of a blue cap sometimes requires skill, as it is a very delicate test. All deputies and firemen should be able to read and understand the instruments called barometer, thermometer, and water-gauge thoroughly, to fulfil the important duties which they are called upon or appointed to carry out, for the general safety of the mine.

SAMUEL DAVIES,
Park View Road, Worsbro', nr. Barnsley.

*Question* 9 (M.)—In longwall workings, explain minutely what is meant by having "the weight" on the face. If too much weight was on the coal, causing it to be crushed into dross, what means would you take to remedy it? If the weight was not sufficient to help the miner as he would like, what would you do to bring it on? Having got it, how would try to keep it regularly on the face? Would you use the same measures at 15 fathoms, as you would at 90 fathoms deep?

*Answer.*—What is meant by having the weight on the face is when the coal comes off well after being holed, say about 3 feet 6 inches, and the holing sprags are taken or drawn without any explosive being used. If too much weight was on the face I would try to remedy it by taking the back props and chocks out which generally eases the roof and takes the weight off the coal face. If the weight was not sufficient to work the coal well, I would try by keeping the goaf well-packed solid from drawing road to drawing road, to prevent it breaking off, and thereby throw the weight on the face. To maintain it on the face I would keep my back props and chocks drawn when required, and the packs kept well up to the face; keep the places moving as quickly as possible, and take every precaution to prevent it from breaking off. In a mine at 15 fathoms the greatest precaution would have to be used, as the roof is generally more tender than at 90 fathoms. I would use the above measures in a mine at 15 fathoms, and in addition, I would pack all solid and use all broken props and bars, in the shape of building prop packs with, at the drawing road sides which would help to steady the roof and keep it from weighting.

WILLIAM PILKINGTON,
324, Church Street,
Westhoughton,
near Bolton.

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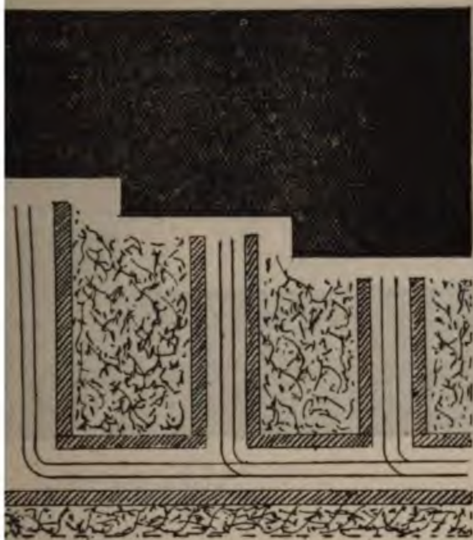
*Question* 10. (M.)—Sketch and describe how you would take out a section of coal pillar 36 yards square, with average roof, and what are the chief points to aim at, and what to avoid in order that as little coal and propwood may be lost as possible.

*Answer.*—I would start at the lower side of the pillar, drive a place end on with the cleat of the coal; turn gates away, first one six yards in, next one twelve yards from it, and another twelve yards from the second,



ng the pillar into three gates of twelve s of coal each. Take stone down in the and gates and pack each side of the s, and keep on shifting the timber forward ie face advances, the packs being kept up also, as shewn in sketch. I would care not to have one lift to lead another much, and at the same time, I would rive to have the far-in lifts to finish first ı they are near to holing. Extra timber be put in so that no more stone need be ed in the road sides. When each place oled, the timber can all be drawn out. chief points, are safety and cheapness, I think this plan would secure them.

JAMES FISH,
116, Bedlington Colliery,
Northumberland.

## ORRESPONDENCE.

: will publish a reasonable amount of correspence per issue, but subject to the following itions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.
ie Editor will not hold himself responsible for any espondence, nor will the publishing of it affirm we hold the same views as the writer.

Murton Colliery.

*To the Editor of "Mining."*

ır Sir,

I notice in Mr. J. Gray's prize essay oring, and also in one of the competition stions in No. 22 of your valuable paper, a statement which is at the present time decidedly incorrect. It is stated that the instrument called the "clinostat," used to determine the deviation of bore-holes, gives the angle of deviation from the vertical plane by the surface of the gelatine. Now, this would be correct in the hydro-flouric-acid method, but not in the clinostat method. The clinostat is now, practically speaking, filled with the hot gelatine, so that there is, in reality, no surface at any rate available. A plumb-line is suspended down the instrument, and the inclination of the plumb-line from the centre line of the instrument will give the angle of deviation from the vertical plane, while the magnetic needle will give the direction of the deviation, the gelatine solidifying and keeping them in position,

Yours truly,
Geo. A. Hawes.

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Chapel Street, Kimberley,
Notts., Jan. 18th, 1894.

*To the Editor of "Mining."*

Dear Sir,

I take the liberty of informing you of my intention to enter in your competition to introduce "Mining" into yet unknown colliery districts. I may state I have persuaded several of my friends at Kimberley to become regular subscribers. I get the paper through ordering at our newsagent's. I am the hon. sec. to the mining class at Kimberley, under the N.C.C., and feel sure the majority of the students will shortly become subscribers. For myself I consider it a most excellent medium for imparting mining instruction, difficult subjects being described and explained in extremely easy and simple ways—a boon to the struggling student. For instance, what is more highly beneficial than the plain and clear answers to recent exam. questions given at various centres, giving the lowly student a good example how the question is dealt with—the style it is written being so brief and yet to the point, and no important omissions contained. I am glad you are embracing the subject of surveying. I shall be much obliged if you will kindly send by return 100 specimen copies of "Mining," and I will assure you each copy will be distributed with a view to an order being given.

I remain, dear Sir,
Yonrs very truly,
David Spence.

*To the Editor of "Mining."*

Dear Sir,

I have followed your work now for several months—in fact, I was so taken up with it that I ordered all back numbers, and have had the first volume bound—that you know. But not until the last two numbers have I read after you on haulage, and I find in No. 3, Vol. 1, and No. 4, Vol. 2, you state that the Climax pulley has a great advantage over the ordinary kind. This I beg to state is wrong, as we have had to dispense with them. We have a gradient of 1 in 22 to haul up, and tubs are put 25 yards apart, and only one at once at the Victoria Colliery, and even with that dip I have had to have half-a-dozen people to pull the rope to the wheel to try and make it grip, but failed, and in one case I put in a 10-inch diameter pulley, and drew the off-rope within 9 inches of the on-rope, and then it slipped. I should be pleased if any persons who have them in use and giving satisfaction, will allow me to see them, as we have four of them on the scrap heap—useless.

Trusting I am not taking up too much space in your valuable little book,

I am, yours truly,
Jesse Hartshorne,
Manager.

Rhodes, Wright & Wroe,
Heckmondwike.

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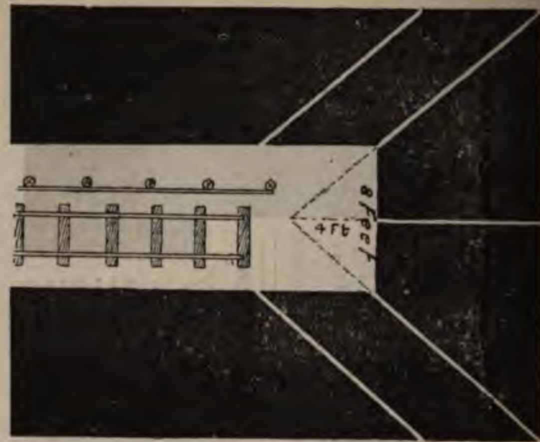
## BORING TOWARDS OLD WORKINGS.

*To the Editor of "Mining."*

Dear Sir,

In No. 4, Vol. II, of your Journal, a correspondent "A. A." asks how the bore-holes are set away at the correct angle. The accompanying sketch shews how this may be done. With the bore-hole straight ahead there is no difficulty, and the flank-holes should be set away at an angle of about 45°. Assuming that the width of the road is 8ft., the direction of the flank-holes may be obtained by taking a point in the centre of the road 4ft. back from the place where it is desired to put the flank-hole.




Yours sincerely,
A. S.

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## "EXAMINATION QUESTIONS"

COMPILED BY

*Mr. WILLIAMSON.*

We have received a copy of the above book, and consider it one of the best compilations of questions we have seen. It contains 660 questions compiled from the various Managers' Examinations, and the whole of the Science and Art questions given at the Examinations since 1882. Price of the book is One Shilling.

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## NOTICES.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

*Printed and Published by* STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MINING STUDENTS.

o 7. Vol. II. SATURDAY, FEBRUARY 24, 1894. FORTNIGHTLY ONE PENNY.


## CONTENTS.



## "MINING"

### THE PRESENT AND FUTURE OF OUR JOURNAL.

WE have just a few words to say with reference to the matter now appearing in our Journal, and of the manner in which we intent to proceed. The subjects at present being treated by continued articles are Surveying and Haulage. The Surveying articles are written by a practical Surveyor, and the simple and efficient manner in which the subject is being dealt with, must indeed be a boon to all students interested in Surveying. The Haulage articles are compiled from the personal knowledge of the writer and from the best works on the subject, principally the Tail-Rope Committee Report, N.E.I. The Glossary of Mining Terms which has for some time appeared in our paper, and which is now almost concluded, must be of great interest and value to those readers who are often confounded as to the correct name of the various appliances, etc., which they see in use in different districts.

The Answers to recent Colliery Managers' Examination Questions are written by a First-Class Certificated and working Manager, and our readers can therefore unhesitatingly rely upon the answers given. These answers are the best possible means a candidate could have to coach him for his Examinations, as they give him to understand how such questions should be answered.

We also insert, from time to time, illustrated articles on the various improvements and appliances appertaining to mining, and reproduce addresses delivered at the various Societies when deemed suitable.

That portion of our paper contributed by our readers viz. :—the Answers to Competition Questions, we have no need to comment upon, as all are aware of its value, and several of our readers have informed us that it has undoubtedly been the means of their obtaining Certificates at the recent Examinations.

The Correspondence pages have of late been much used by our readers, and it has by no means been the least interesting reading matter. We hope it will be made still further use of, and entreat those who have any information to impart, or a question to ask, to make use of these pages, and if, at any time, sketches are required to illustrate the question or the answer, we shall be pleased to have them made, providing a rough sketch be sent us.

Our subscribers generally are of the opinion that we publish the best mining educator extant for mining students, and especially for intended candidates for certificates, besides being the cheapest, in fact, the only penny illustrated mining educator. We are of the same opinion as our readers, yet we are not satisfied, and have determined to make it still better. With this end in view, we have made arrangements with Mr. CHARLES LATHAM, Lecturer to the University College and County Council of Notts, to write a series of articles specially for our Journal, the first of which on

"COAL: ITS HISTORY AND COMPOSITION,"

will appear in our next issue. The name of the writer is sufficient to guarantee the excellency of the articles, and can assure contributors there will be no cause for disappointment.

As our readers are well aware it is impossible, with our limited space, to treat with the whole of the subjects just spoken of in each issue, but we will do our utmost in this matter.

We owe many thanks to those readers who have taken the trouble to give specimen copies to their friends, as we can assure them that we have derived great benefit from it, and if this help will only continue for a few months longer, we hope to overcome the difficulty mentioned above, namely, lack of space, by increasing the number of pages in each issue.

Yours sincerely,

THE EDITOR OF "MINING."

# EASY LESSONS ON MINE SURVEYING

**For BEGINNERS.**

*Commenced in Number 2, Volume II.*

## SCALES.

The student should now know how to construct a scale, and its application. It is in constant use with the surveyor, and as such, its use must be thoroughly understood by the beginner. As was explained in our introductory article, a plan (at least for mining purposes) is a miniature of the object intended to be represented. The plan is made of a size which is in proportion to the object, and everything delineated on the plan is in its exact position, and is the same distance from each other (*i.e.* comparing the different sizes of the plan and the object) as upon the actual object of which the plan is made. To make this point clearer, let us assume that a plan with a scale of an inch to a mile is required to represent a triangular field, whose sides measure 6 miles, 4 miles, and $3\frac{1}{2}$ miles respectively. To make this plan of the field all that is required is to make a triangle whose sides shall be 6 inches, 4 inches, and $3\frac{1}{2}$ inches respectively, care being taken to place the sides in the correct order. (See Problem III, No. 4, Vol. 2.) There are 1760 yards in a mile, or 63360 inches, so that the field is in reality 63360 times as large as the representative plan.

Again, let us suppose that the plan of the above field was given to us to ascertain the lengths of the sides, and the scale was written on the plan as being "an inch to a mile;" then by simply applying an inch scale to the sides we would find that they measured 6 inches, 4 inches, and $3\frac{1}{2}$ inches respectively, and would therefore come to the correct conclusion that the length of the sides would be the same number of miles. It will be evident to the student that instead of taking an inch to represent a mile we might take any length we choose, perhaps $\frac{3}{4}$ths of an inch, or $4\frac{1}{8}$th inches, and by making a scale on the plan similar to that by which the plan has been made, the lengths of the sides or any distance whatever upon the plan could afterwards be found by referring to the scale on the plan. Likewise, instead of having our scale, an inch to a mile, we could have it an inch to the yard, foot, 20 yards, 32 yards, etc., as was required. The workings of a mine are usually plotted to one or other of the following scales:—

20 yards to an inch
22 " or 1 chain, to an inch
30 " to an inch
32 " "
40 " "
44 " or 2 chains, to an inch,

though the various plans necessary for the work of a colliery are of many different scales. Thus the Ordnance Surveys are published on plans of "an inch to a mile," etc., while other small plans may be four feet to an inch, or even the same size of the object. With this explanation of the application of scales we will proceed to the problem.

X. To construct a scale of equal parts.

By means of a compass or dividers lay off a number of equal divisions (Fig. 44) AB, BC, CD, etc., and AE, and divide AE into

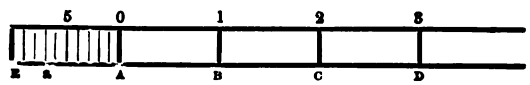


Fig. 44.

10 equal parts. Then, if we assume that the large divisions each represent 10, each of the small divisions in AE represents 1. Or if each of the large divisions represents 100, each of the small divisions represents 10. Hence, in the first case the distance from C to *a* would represent 27, or in the second case 270. Or again, we may assume that each of the large divisions represents one, then the smaller ones represent tenths, and the distance from C to *a* would be 2·7.

We will now leave the subject of Geometry for awhile, and look into the elementary part of

## MENSURATION.

PROP. I.—To find the area of a rectangle when its length and breadth are given.

Multiply the length of the rectangle by its breadth, and the product will be the area.

Example 1.—If the sides of a rectangle are 12 and 9 feet respectively, what is its area? Answer: $12 \times 9 = 108$ sq. feet.

Example 2.—How many sq. feet are there in a table which is 10 feet 5 inches long, and 3 feet 8 inches broad? $10\frac{5}{12} \times 3\frac{8}{12} = \frac{125}{12} \times \frac{44}{12} = \frac{1375}{36} = 38$ sq. feet, 28 inches.

(This Proposition also includes the finding of the area of a square, for a square is a rectangle with its sides equal, therefore its area equals the length of one side multiplied by itself, or the side squared.)

PROP. II.—To find the area of a rectangle when the base and diagonal are given.

First find the other side, and then find area by the last problem.

Example.—Let ABCD (Fig. 45) be a rectangle whose diagonal BD equals 125 feet, and whose base BC equals 100 feet. Find the area. From what was shewn in the Geometrical Theorems, the square on BD equals the sum of the squares on BC and DC. Therefore $CD^2 = BD^2 - BC^2$, $\therefore CD = \sqrt{(125^2 - 100^2)} = \sqrt{(15625 - 10000)} = \sqrt{5625} = 75$. Now we have got the dimensions of BC and CD, so the area of the rectangle $= 100 \times 75 = 7500$ sq. feet $= 833$ sq. yds., 3 sq. ft.

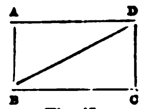

Fig. 45.

Prop. III.—To find the area of a parallelogram. Multiply the base by the height, and the product will be the area.

Example.—Let A B C D (Fig. 46) be a parallelogram, and let the length of BC be 5. Then if the height or EA is not known it may be measured with the scale. Let EA measure 3. Then the area equals $3 \times 5 =$ 15 square feet.

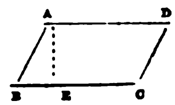

Fig. 46.

Prop. IV.—To find the area of a triangle. Multiply the base by half the height, and the product equals the area.

Example.—Let ABC (Fig. 47 be a triangle whose base BC equals six feet, and whose height DA equals seven feet. Then $6 \times \frac{7}{2} = 21$ square feet area.

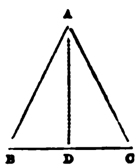

Fig. 47.

(NOTE.—The height AD is a perpendicular dropped from the apex A to the base BC.)

*(To be continued.)*

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The following are a few questions which the student should work out for himself. If any reader has a difficulty in working them we shall be glad to help him.

### QUESTIONS ON THE LESSON.

(1) Find the number of square yards in the floor of a room which is 24 feet, 9 inches long, and 15 feet, 6 inches broad.

Ans.—42 sq. yds., 5 ft., 90 ins.

(2) How many square acres are contained in a rectangular field, whose diagonal is 320 yards, and base 240 yards?

Ans.—10 acres, 1 rood, 39·29 poles.

(3) What is the area of a parallelogram whose base and height are 25 feet, 3 inches, and 15 feet?

Ans.—328¼ feet.

(4) What is the area of a triangle whose base is 21 feet, 6 inches, and height 14 feet, 6 inches.

Ans.—155 sq. ft., 126 ins.

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## EXAMINATION QUESTIONS,

**With Answers,**

By a First-Class Certificated Manager.

*Commenced in No. 5, Vol. II.*

The following questions for the Examination of Candidates for Certificates of Competency were set in the Manchester District, December, 1892.

### Practical Working of Collieries.

**(Continued.)**

Question 3.—Under what circumstances would you use compressed air underground? What are the advantages and disadvantages of its use?

Answer.—I would use compressed air underground under the following circumstances:—In coal cutting or rock boring by machinery, also in hauling and pumping underground at long distances away from the shaft, when it would be difficult and a great nuisance to have steam and other motive power is very difficult to be obtained, and inapplicable altogether.

Its advantages are:—That it can be taken to any point in the mine; the exhaust from the engine cools the mine, and helps the ventilation to a certain extent.

Its disadvantages are:—That it requires a large surface plant: great loss of power, useful effect obtained from 25 to 30 per cent.

Question 4.—If you were called up in the night and found the engine-house (containing the winding-engine, drums and ropes) on fire, how would you proceed?

Answer.— I should turn off steam at the boilers from the winding engines, clamp the ropes and rods over the pit mouth, in case the fire could not be overcome before these things were burnt off and liberated. By this means I should prevent them falling down the shaft. After this I should connect a hose-pipe to the donkey pump (which is used for the purpose of feeding boilers with water) and commence pumping and directing the water on the flames until they were subdued.

QUESTION 5.—What are the disadvantages (if any) of using cast iron tubbing in a furnace shaft, and what would you do to overcome them?

ANSWER.—The disadvantages of using cast iron tubbing in a furnace shaft are the deterioration of the iron caused by the following agencies:—(1) The gases given off from the combustion of coal used in the furnace; (2) Water, which is frequently made in shafts, contains substances in solution which are very injurious to the iron; in fact, either of these agencies is very injurious, but when combined are more so, as they rapidly eat away the iron to such an extent that in a few years time the nature of the iron is completely destroyed.

To avoid this a lining of fire-brick, built with cement, is mostly used for this purpose in furnace shafts, and is about the best method. The objection to its use is that it is difficult to detect a leak because of the iron being completely covered, but the benefit derived from covering the iron with brickwork outweighs by far the objections.

QUESTION 6.—State what, in your opinion, are the two most serious accidents in mines, giving the reasons for same.

ANSWER.—The two most serious classes of accidents in mines are:—(1) Falls of roof and side; (2) Explosions. Taking the statistics of the number of lives lost each year, falls of roof and sides heads the list. Accidents of this class frequently occur owing to men putting too much trust and confidence in the nature of the roof, whereby if a systematic method of timbering was strictly adopted, I have no doubt whatever that accidents of this class would greatly diminish. Explosions are sometimes caused by naked lights, defective lamps, blown-out shots aggravated by coal dust, coming in contact with gas which may be a sudden outburst or gas harbouring in old goafs, which, by a sudden depression of the atmospheric pressure, suddenly makes its appearance, and it is at such times as these that by the act of one careless person a terrible explosion may take place. To reduce this class of accidents the C.M.R.A. General Rule 1, ventilation, should be strictly observed; safety lamps should be used; strict discipline put forth; and the C.M.R.A. strictly enforced. Explosions have occurred and although the strictest enquiry has been made, a thorough solution of the cause of the accident has not been obtainable.

It struck me very forcibly whilst answering the question of accidents in mines that the best means to reduce them is to educate, in the principles of mining, all those who have to work in the mines. And in what way can it be done? No better plan can be adopted than to read this paper carefully and work out the various problems contained therein, and should you not be able to understand anything you can always ask through the correspondence page various questions, which in due time will be answered.

(*To be continued.*)

## PRIZE COMPETITION.

### QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by March 3rd, 1894.

*Question* 1. (E.)—Describe the apparatus used for finding (*a*) the moisture in the air; (*b*) the pressure of air in airways; (*c*) the velocity of air in air-ways, and the principle of action of each.

*Question* 2. (E.)—What number of bricks are required to line a shaft 14 feet diameter, 120 fathoms deep, and 18-inch wall? (1000 bricks equal three cubic yards.)

*Question* 3. (E.)—How are lifts arranged in a deep mine pumping engine?

*Question* 4. (A.)—Plot the following irregular field which was surveyed by running a base line through it from end to end (A to B) with off-sets taken as shown in the adjoining column:—

| LINKS. | CHAINS. | LINKS. |
|---|---|---|
| | B | |
| 150 | 15·5 | 0 |
| 182 | 13·0 | |
| | 12·48 | 175 |
| | 11·59 | 55 |
| | 9·80 | 183 |
| 280 | 8·65 | |
| 202 | 3·93 | 92 |
| | 1·50 | 75 |
| 145 | 0·45 | |
| | A | |

*Question* 5. (A.)—What construction of screen is best adapted to prevent breakage of coal in screening?

*Question* 6. (A.)—What are the special advantages and disadvantages of steam pumping engines placed underground?

*Question* 7. (H.)—Give an account of installation for producing and distributing compressed air underground.

*Question* 8. (H.)—Show, by sketch, how steam boilers are built in, and heated gases conducted from the fire-grate to the chimney.

*Question* 9. (M.)—Give a description of the coal and roof of a seam you are well acquainted with, and describe fully the method of working it, and the advantage of the method adopted as compared with any alternative method. Make a sketch of same giving distance between roads. Also under the various heads of a cost sheet the approximate cost per ton of coal raised.

*Question* 10. (M.)—Describe, with suitable sketches, *Cooke's* Ventilating Machine.

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Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

# THE SUSSMAN ELECTRIC LAMP.

AS our readers are aware several portable Electric Lamps have been introduced with a view to replacing the ordinary safety oil lamp, but up to the present time none of them can have been said to have met with very much success. The lamp under discussion is however a comparativey new invention, and has not yet come before the public to any practical extent, but from the numbers which have been tried at various collieries throughout the kingdom and reported advantageously upon it would seem that at last a practical substitute for the oil lamp has been produced, at least for the lighting of our collieries. As will be seen by the accompanying illustration of this lamp, its shape is, in our opinion, far superior to that of our oil lamps. The weight and size of the electrical lamps previously brought to notice, have in the majority of cases been a very significant objection against them becoming popular. The weight of the Sussman Lamp however is only about 3 lb. 10 oz., though there is still about half a pound in favour of the oil lamp. There is practically little difference in the dimensions as will be seen by reference to the illustrations, both of which are drawn to a scale; the dimensions of the electric lamp being about 2¾ inches square by 8 inches high. It is claimed that the light given by this lamp is far superior to that of the best oil lamp at present in use, and will burn without perceptible diminution in intensity for a period of from 14 to 16 hours, in which case nothing further can be expected in this direction. Now, a word with regard to the most important of all the factors which a colliery lamp is required to possess, namely, safety. The most incontestable of all arguments is that which can stand practical tests; now, many experiments have been made in order to test the safety of electric lamps in an explosive atmosphere, and in every case the light has gone out consequent on the breaking of the glass surrounding it before any explosion could occur. In our mind there is no doubt whatever as to electric lamps being safe, though some authorities express doubts about it. An important and unique advantage which the lamp in question possesses over every other lamp yet produced, is the fact that the battery is a dry one. This lamp offers exceptional advantages for examining the roof of the mine or awkward

places in so much that it can be placed in any position without fear of the light going out, even immersing it in water is without effect. Many miners at the present time would prefer using the old form of Davy lamp if they were allowed, even with its meagre light, to the more recent oil lamps, as it does not go out so easily. The advantage which the electric lamp offers therefore in this respect is of no small consequence, and as this lamp is made exceptionally strong, it is capable of withstanding rough usage. These are the advantages of the lamp, but there is one disadvantage which this lamp possesses as likewise does all other electric lamps hitherto produced, it cannot be used for gas-testing purposes, even if the lamp was generally adopted, the oil lamp would still retain its position as a deputy's lamp if some other means of testing cannot be instituted, and we understand that investigations are being made at the present time with a view of attaching an arrangement to the electric lamp for this purpose. The owners of the Sussman lamp are evidently assured as to the success of the lamp, as they offer to supply it upon exceptional terms; many large collieries have already intimated that they will adopt them immediately the Company are in a position to supply them, and have given orders for trial installations.

The following are its chief advantages:—
Colliery Owners will not be required to outlay capital upon the purchase of them. The whole responsibility of supplying them, keeping them daily charged, and in thorough order, will be undertaken by the Company, *the inclusive charge* being 4d. per lamp per week.

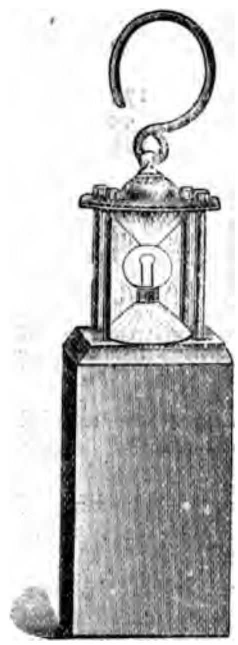
It gives a steady clear light of a power far superior to the best modern safety oil lamp.

It will burn with a steady light from 14 to 15 hours, and as no trimming or attention is required, no time is lost, as at present, in taking lamps to the lamp station.

The lamp measures only $2\frac{3}{4}$ inches square, and 8 inches in height, and weighs a trifle over $3\frac{1}{2}$ lbs.

As the battery contains *no liquid* (the whole interior being in one solid mass) the lamp can be used while lying upon its side, or in any other position, without the least injury resulting.

Not only can the miner not tamper or obtain a light from this lamp, but ***it is impossible to ignite gas*** with it, whatever accident or breakage may occur.



**The Sussman Electric Lamp.**

**The Present Type of Oil Lamp.**

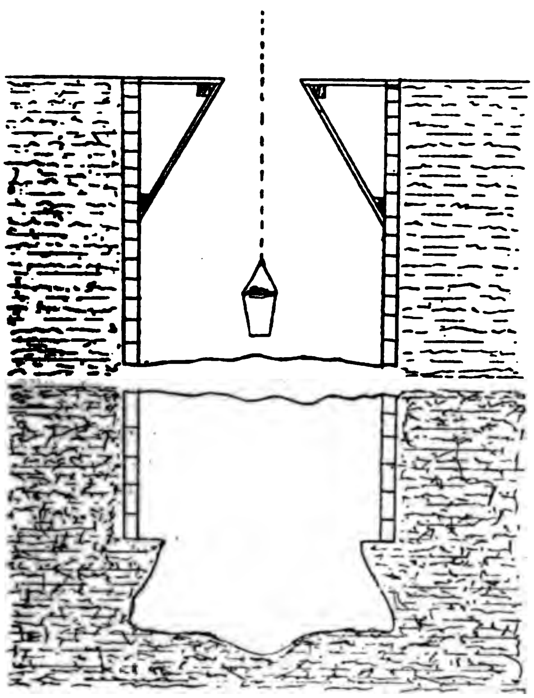
(The Illustrations are both drawn to the same scale.)

The matter is at present in the hands of the Electric Exploitation Company, Limited, of 37, Wallbrook, London, E.C., who are making arrangements for the manufacture and supply of the lamps upon a large commercial scale.

## ANSWERS TO QUESTIONS

**In No. 5, Vol. 2.**

*Question* 1. (E.)—Describe, with sketch, a good method of guiding the hoppit or kibble (in a sinking shaft) when nearing the surface.



*Answer.*—A method of guiding the hoppit in a sinking shaft, when nearing the surface, is illustrated by accompanying sketch. The top of the shaft is covered with ordinary baulks and woodwork, with the exception of a square portior in the centre. From the perimeter of this orifice slabs of wood are fixed at an angle downwards, and are secured to the sides of the shaft. The guide boards are fixed all round, and should be at least 15 feet long, though very much will depend upon the size of the orifice at the top of the shaft, and also on the size of the shaft. The speed of the hoppit should be reduced, when nearing the surface, to a considerable extent, as too much care cannot be exercised to prevent anything falling down the pit on to the sinkers. For sinking purposes, however, I very much prefer the application of guide rods in the shaft, as recommended by your competitor, Will. Halliwell, in your last issue (No. 3). Where guide rods are used there can be no swinging of the hoppit from side to side, which is a great consideration; neither can there be any twisting, which is so objectionable in a sinking shaft, where round wire ropes are used.* Flat ropes may to a certain extent prevent the hoppit twisting and swinging, but the great objection to this method is that the ropes are generally of no service after the sinking operations are finished, while with round ropes they can always be used for some purpose about a colliery. As was mentioned in No. 3 of "Mining," the guides are used to carry the bricking scaffold which, when used in connection therewith, must always prove a great success.

* Non-twisting round ropes are now in use for sinking purposes.—Ed. of M.

THOS. LITTLER,
234, Woodhouse Lane.
Wigan.

---

*Question* 2. (E.)—How would you test for gas in a mine with an ordinary safety lamp?

*Answer.*—The mode usually adopted in mines for ascertaining the presence of gas is by means of the ordinary safety lamps in general use in coal mines. Many of these are immediately extinguished in the presence of firedamp ($CO^2$), and black-damp or stythe ($CH^4$), which, although perhaps conducing to safety in so far as preventing the ignition of an explosive mixture is concerned, yet cause a considerable amount of inconvenience. The common "Davy" safety lamp, encased or surmounted with a bonnet, is preferred by most practical firemen or deputies for examination purposes. Before commencing to search for gas we should take care that the safety lamp was in proper working order, clean, and securely locked. When entering a place to examine for the presence of fire-damp we should carefully subdue the light by drawing down the wick with the pricker (for a small quantity of gas can be detected easier with a subdued light than by a large flame), then holding the lamp in one hand and screening the eyes from the light with the other, carefully and slowly raise the lamp towards the roof or highest points, and if fire-damp be present there will be a faint blue halo or cap surmounting the top of the flame. When the air contains about 3½ per cent. of fire-damp the blue halo or cap increases in length as the percentage of gas increases until, when about 6⅔ per cent. of gas is present, there is a feeble explosion (we cannot term it anything else) which extinguishes the light, thus leaving the fireman to grope his way out.

In searching for black-damp, stythe, or carbonic acid ($CO^2$) the lamp—with a good light on—is carefully and gradually lowered down towards the floor. If this gas is present the light of the lamp burns dim and less brilliant, and it gives a brown appearance to the halo or cap. When the air contains about 8 per cent. it will extinguish lights, and is very dangerous to breathe. Being of great density it is often found in low places or dip workings, in old unventilated workings, and at the bottom of unventilated wells and shafts. Mr. Editor, I beg to make reference to another safety lamp called the "Pieler" Safety Lamp, used for this purpose, but I don't think that it will ever come to use in such a common and popular way as the common "Davy" lamp, except some better adapted improvements than at present are effected.

SAMUEL DAVIES,
Park Road View,
Worsbro Bridge,
near Barnsley.

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*Question* 3. (E.)—What is meant by proving a coalfield?

*Answer.*—By "proving a coalfield" we mean a preliminary examination in prospecting or searching for coal-bearing rocks in such a district. This is very important and necessary to prove the existence of the different coal-seams (if any), and to ascertain the nature of the surrounding rocks in which the coal is inter-stratified, or found in that coalfield. To prove that workable seams were situated in the rocks, at workable depths, we would proceed as follows:—(1) Take particular notice of the geological maps, etc.; examine all the rocks in roads and railway cuttings, in deep sewerage drains and wells, on mountain sides or the slopes of valleys, and being satisfied with such prospecting in the neighbourhood (2) we would proceed at once to prove the field by the process of trial borings, to find the course or direction of the general dip of the rocks, and how this will affect the possible continuity of the seam or seams. (3) The depth, thickness, quality, inclination, and the amount of dislocation of the seams. (4) The probable cost of sinking, and the natural difficulties arising from quick-sand, clay, gravel, and water-bearing strata, the correct record being kept by the master borer of the various strata bored through, in sections. (5) If the strata is subject to dislocations such as dykes, faults, &c., their directions should be perceived either east and west, or north and south; then it would be advisable to set a series of say, three or four bore-holes in a line north and south, and two or three bore-holes on a cross line or east and west. By adopting this plan we would ascertain correctly the amount of inclination of the seam or seams, of the whole strata.

SAMUEL DAVIES,
Park Road View,
Worsbro' Bridge,
near Barnsley.

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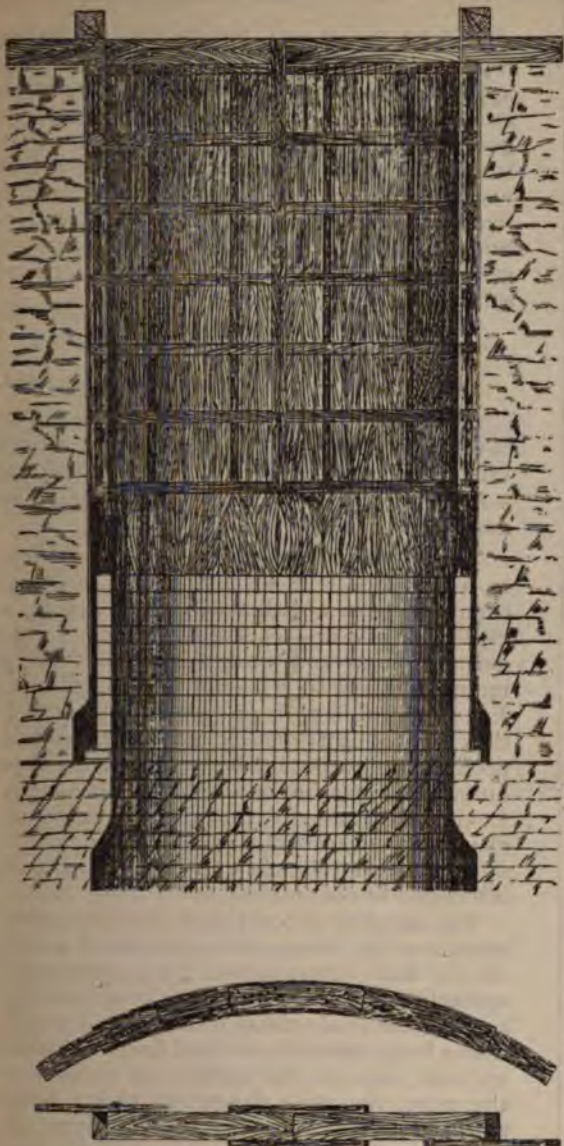
*Question* 4. (A.)—How would you proceed to timber a shaft with wood lining, giving a sketch of same?

*Answer.*—In timbering a circular shaft cribs or curbs rings formed of segments of wood are prepared, being made of oak or elm, joined together with cleats top and bottom, and sometimes with over-lapping joints. Then they are prepared to fit the dimensions of the shaft, having the joints in the direction of the radius of the circle, and they will, when six inches square, resist a heavy pressure from the sides. The shaft is sunk to the depth of from six to nine feet, and the crib is placed perfectly level on the bottom; on to this crib punch props, about three feet in length, are placed, on to which the next crib is laid. Behind the cribs backing deals are placed, about one-and-a-half inches thick, which make a close binding. If necessary, the cribs or curbs can be placed close together, called solid timbering. The whole structure may be suspended by stringing deals—planks about three inches thick—which are attached to baulks laid across the top of the shaft. This method of timbering is usually adopted until a good stone head is reached, when a broad crib of wood or iron is put in, on to which the brick walling is placed. In a rectangular shaft, the sets of timber are generally notched at the ends, and when fixed from a frame an average size would be six inches broad, and from eight to ten inches in depth. In ordinary ground the sets are placed from two to four feet apart, and props or straddles are put on each corner of the frame to support the set above. Behind the sets, planks are put in, about one-and-a-half inches thick, which keep out all loose material. For greater security the sets can be placed close together. The side pieces are called wall-plates, and the short pieces end-pieces. Dividings are put in which give great support to the sides.



Sketch for Questions 4 and 6.

JAMES BURROWS,
103, Chapel Street,
Dalton-in-Furness.

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*Question* 5. (A.)—A place used as a sump or lodge room is 45 yards long, and averages 7 feet wide by 6 feet high. How many gallons of water does it contain, allowing $6\frac{1}{4}$ gallons to each cubic foot?

*Answer.*—To find the quantity of gallons in a sump as stated in the question, we must first find the cubical contents of the sump in feet. The length of the sump is given in yards, which will have to be reduced to feet as follows:—

45 yards × 3 × 7 feet, × 6 feet = 5,670 cubic feet in the sump. Now, as a cubic foot contains $6\frac{1}{4}$ gallons, 5,670 × $6\frac{1}{4}$ or 5,670 × 6·25 (which is equal to $6\frac{1}{4}$) =

| | |
|---|---|
| $\frac{1}{4}$) 5670 | 5670 cubic feet. |
| 6 | 6·25 |
| 34020 | 28350 |
| 1417·5 | 11340 |
| | 34020 |
| 35437·5 | 35437·50 |

35437·5 number of gallons in the sump.

GEORGE BELL,
Shotton Colliery,
*via* Castle Eden,
Durham.

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*Question* 6. (A.)—Describe, with sketch, the method of walling a shaft through ordinary strata.

*Answer.*—After the sinking has proceeded for some time, it is necessary to protect the sides of the shaft by walling. It is first necessary to lay a bricking ring or walling crib, which operation is as follows:—First a piece of stout timber is placed across the shaft, and a hole bored through the centre, through which is passed a strong copper wire and a heavy plumb-bob hung on to its lower end. It is then let down to within a few feet of the bottom and allowed to steady itself, which of course marks the centre of the shaft. A rod or staff, which is cut exactly the radius (half the diameter) of the shaft, is then used to describe the circle by measuring from the centre line to the inner edge of the segments of each ring as they are laid down. Then, in order to obtain a perfectly level bed, a straight edge and spirit level are used. The segments of the ring are then fitted together and brought to the exact circumference by driving wood wedges behind them, and between the ring and sides of the shaft. The bricking may be commenced in the following manner:—The work has to be done from a platform or cradle made the same shape as the shaft and a few inches less in diameter so as to enable it to be lowered and raised as desired, and it is supported, or rather hung, upon four or six chains which are gathered together in a large D-link and attached to

the winding rope. The cradle can thus be raised up as the bricking advances. The bricks and mortar are sent down in a trunk or kibble and handed round by the labourers, the whole scene presenting a lively appearance. As the walling nears the stone which was left under the last length it is necessary to use great care so as not to disturb the upper brickwork. This is cut out by chisel and hammer, and in lengths of only a few feet at a time. It is then immediately bricked up, and as the wall reaches the crib on which the upper brickwork rests they are tightly joined by driving oak wedges between the top course of bricks and the under side of the ring, and the other part is treated in the same way until the circle is complete. Sinking operations are then commenced.

MATTHEW MOURLEY,
Rock Terrace,
Soothill Lane,
Batley, Yorks.

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*Question* 7. (H.)—Describe, with details, some variety of safety catches, and state the conditions necessary to ensure safety with such contrivances.

*Answer*.—*Broadbent's* Patent Safety Cage has a pair of eccentrics placed on each side of the guides, and so arranged that they are kept from pressing upon the guides, when the cage is descending at the ordinary speed, by suspension chains. In case of the rope breaking, the chains are slackened and a spring forces the eccentrics against the guides with sufficient force to prevent the cage from falling down the shaft. This appliance can be made to act upon wood or wire-rope guides.

*Ormerod's* Safety Cage has catches on each side of the guides. These catches are kept clear of the guides by means of a dead weight fixed on a vertical rod which passes through a hole in an adjustable plate at the top of the cage. Between the plate and the weight a spring is coiled round the rod. Below the plate the rod is provided with a projection which acts upon a lever attached to the catches, which are thus prevented from coming into action during winding. Should the rope break and the cage begin to descend rapidly its momentum overcomes the weight, relaxes the spring which forces the catches against the guides, and arrests the descent of the falling cage. The catches can be put in and out of gear when required, and held in either position by means of a lever, so that the catches can be thrown into action and the strain taken off the winding rope during repairs in the shaft. It is claimed that this apparatus will act on wood or wire rope guides. Safety catches have not come into general use because they are liable to cause trouble by coming into action during a fast winding and have been known to fail when required, owing to their being out of order. Such contrivances should be frequently examined and kept in good order to ensure safety.

SAMUEL THORPE,
Chevet View,
Ryhill, Wakefield.

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*Question* 8. (H.)—In what way may danger arise from coal dust in mines? What method would you employ for counteracting he danger?

*Answer*.—The dangers arising from coal dust in mines are, that when a blown-out shot occurs there is a probability of it raising a cloud of very fine coal dust, which suffers decomposition and feeds the flame, thereby increasing the destructive force of an explosion. Experiments have been made which prove that highly inflammable coal dust would produce an explosion when present in large quantities, even in the absence of fire-damp. Coal dust therefore becomes a most dangerous element in the art of coal mining, and demands most careful study and care on the part of all interested in coal mining.

The dangers of coal dust may be safely overcome by the careful removal of a part of the dust accompanied by a systematic sprinkling of water on the roadways, thereby keeping the roads clean and damp. In some mines large quantities of coal dust are loaded up and sent to the surface or gobbed in the mine, the most dangerous places being sprinkled with water, and then swept up. Mechanically-arranged water carts have been introduced, by which a spray of water is thrown upon the roof, floor, and sides of the roadway during the motion of the cart. The most common and most practicable method is by means of the common water barrel, having a plug hole in the end, with a two-inch pipe attached. The plugs are withdrawn as required, and the water flows either in a stream or in a spray. Various other methods are employed in watering the roads, but the principle is the same in each. Impure salt has been employed in Staffordshire, and was reported to be giving satisfaction. It was stated that nine tons was required for

ry five hundred yards of roadway, which iired to be done every week for the first ıth, and once a month afterwards. This hod does not appear to meet with much ɔur, probably due to cost and extra work iired.

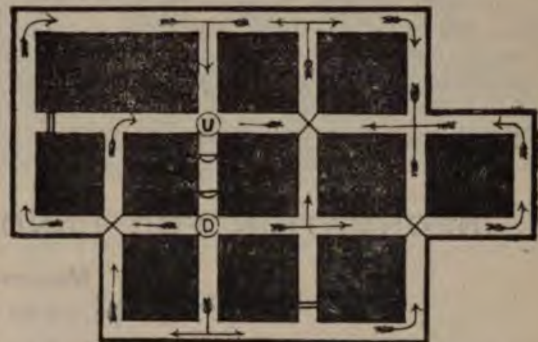
GEO. ROBINSON,
Dallas Villas, Langwith,
Mansfield, Notts.

*uestion* 9. (M.)—Describe, with sketch, the hod of working coal by the "Longwall" em, giving the distance apart of roads, under what circumstances it is most antageous.

*nswer*.—In this method of "Longwall" king it is the total removal of the whole ıe coal in one length of breast, and in one ɔle operation, the working face being ·ly end-on in the leading stall, and cross s are opened out from every 20 to 30 ls apart according to the nature of the and roof, and as the new cross gates ance along, the old ones are cut off to ıce the extra labour, expense, and to e better exit for the coal, the width of the of leading stall, ten feet; branch or s gate, seven feet. Gate packs are three ls wide, and gob pack six feet wide, built stone out of the gob. The gate packs ɔut on with the ripping out of the gateway ılarge the height of the horse road. It is ıntageous, because a larger amount of can be got for the smallest amount of ur, and a larger per cent. of large coal be excavated in this method of working.

HERBERT HALL,
15, Yardley Row,
Ryhill, Wakefield.

*Question* 10. (M.)—What are the benefits derived by splitting the air? Where should the splits be made, and where should they join again in order to reap the greatest advantage? Give a sketch to illustrate the principle.




D Downcast || Stoppings
U Upcast X Air Crossings
D D Doors Direction of Air Currents shown by Arrows

*Answer*.—The benefits and advantages derived by splitting the air in mines are known to be great, and in all well-managed collieries we find the air split up into separate districts as far as is practicable. Even not very long ago, the air current in mines used to be carried in one stream right from the down-cast round the workings to the up-cast. It will readily be seen that an explosion occurring in any part of the mine was liable to prove disastrous all through the pit, and the friction arising through conducting the air in one current through the mine was very great. In order to reduce the direful effects of an explosion and to increase the quantity of air in mines with the same power applied, Mr. BUDDLE, a viewer in the North of England, introduced the system of "splitting" by which one part of the mine could be ventilated by a current of fresh air, which, after having done its duty, returned to the up-cast, and did not go through and round the whole of the mine. Other portions or districts were ventilated in the same manner.

The advantages derived by splitting the air may be enumerated as follows:—(1) The total quantity of air in the mine is increased without increased water gauge. (2) We get an increased quantity without increasing the velocity, except in the shafts. The velocity in the main returns is kept from being dangerously high, which is often the case in mis-managed mines. (3) Each district has its own supply of fresh air, and its own separate returns. Consequently, any gas coming off a particular district is carried to

the up-cast, and not into the other workings. (4) If an explosion occurs, only the particular district in which the occurrence happened would be affected and perhaps scores of lives saved.

In order to reap the greatest advantage from splitting the air in mines, the in-take should commence as near the downcast and terminate as near the up-cast as possible, it will readily be seen that if we join the currents again at a considerable distance from the up-cast we have what we are wishing to avoid, viz.:—A high velocity from the junction to the up-cast, and since the friction is as the square of the velocity, there is a waste of power. The same applies to the commencement of the intakes from the down-cast. The enclosed plan illustrates the method of splitting.

WILL LITTLER,
234, Woodhouse Lane,
Wigan.

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# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MININ STUDENTS

Vol. II. SATURDAY, MARCH 10, 1894. FORTNIGHTLY ONE PENNY.


CONTENTS.



## MINING LECTURES


BY C. LATHAM,

turer to the County Council and University of Notts.


*(Specially written for this Journal.)*

### LECTURE I.

L: ITS HISTORY, COMPOSITION, & USE.

the past a great many writers have written as to what they termed the et of England's greatness, some advanc- one idea, some another, but all agreeing ne point, namely, that the source of her er was coal.

would be impossible for any one to over- the very great part which the mining istry has played in the past, and if we in future are to go on with increasing ess, then it is more than necessary that one of us should have at least some ht knowledge of the many agents of ire with which we are brought in daily act.

ow can we obtain this knowledge is a stion often asked, and in some cases ly answered, by joining some Mining ruction Class; but there are many ngst us who can not for various reasons o, and to those the only way open is the study of some text book on the subject. Unfortunately we find most of the present day text books are written in language which the average miner is unable to clearly understand; frequently we see laws laid down and principles stated without any reason being given in explanation of their use. In the articles which will appear from time to time under the above heading, it is our wish to place before our readers valuable information put into simple language, such as would be used in class instruction, and in so doing we feel quite sure we shall supply a long felt want.

### HISTORY OF COAL.

In writing a history of coal one is taken back in imagination millions of years into the past, and the task of recording what took place at that time, the time when our coal was being formed, is by no means an easy one.

It is true a lot is left to the imagination of the writer, but fortunately we are not quite left in the dark as regards actual facts, but by turning to the rocks enclosing the coal seams we find stamped upon them a fairly clear description of the kind of life and vegetation which existed at that remote period.

### WHAT IS COAL?

It is scarcely necessary at the present day to attempt in a series of arguments to prove the vegetable origin of coal. The bright glossy mineral which warms our homes, which works our mills, which drives our trains, which propels our ships, and which plays so important a part in the manufacture of iron, does not at first sight call to mind the towering pine or the graceful fern.

But if we wish to trace out the connection for ourselves we have two ready methods, (1st) by chemical analysis, and (2nd) by examination under the microscope. Let us subject a piece of coal to a few chemical tests and we find it consists chiefly of Carbon, Hydrogen, and Oxygen. In the same way a piece of ordinary wood may be shown to contain the same elements, the only difference being one of appearance, which is solely due to the difference in proportion in which the various substances are combined, and not any differences in kind.

It is an easy matter for us by the aid of the following table to trace the gradual change from wood to coal, although the exact point where wood ceases to be wood and becomes coal is not so easily defined:—

| | Carbon. | Hydrogen. | Oxygen and Nitrogen. |
|---|---|---|---|
| Wood .. .. .. | 48·94 | 5·94 | 45·12 |
| Peat.. .. .. .. | 55·62 | 6·88 | 37·50 |
| Lignite .. .. .. | 69·94 | 5·95 | 24·11 |
| Bituminous Coal .. | 88·42 | 5·61 | 5·97 |
| Steam Coal .. .. | 92·10 | 5·28 | 2·62 |
| Anthracite .. .. | 94·05 | 3·38 | 2·57 |

If we look carefully at the first column of the table, we see at once that during the change from wood to coal, the quantity of carbon increases; the second column shows us that the quantity of hydrogen remains pretty much the same, and the third column that the quantity of oxygen and nitrogen decreases until in anthracite it becomes very small indeed.

Let us now turn to the second part of our examination, and having rubbed a piece of coal sufficiently thin for us to see through it, place it under the microscope. We notice at once it consists of fine vegetable matter tightly cased together, and we are also able to make out a number of small round particles pressed flat, looking something like little bags. These are the seed cases of many of the plants which went to form the coal, and when the seed which they contained are present in large numbers, we get a coal of the bituminous class, the bright flame we notice when such a coal burns being due to the amount of highly combustible matter contained in the seeds.

In most coal seams and more often in the rocks containing them, we come across a large number of what we know as fossils. These fossils consist of the impression of the bark of a tree, the leaf of a fern, or the fruit of some plant which have become stamped upon the rocks when the coal was forming, and they, if further evidence were necessary, afford ample proof as to the nature of the material, which flourished and died, and after long years became transformed into coal.

### The Plants that form Coal.

Having established the main facts as to the vegetable origin of coal, we will now go a step further and examine some of the many plants from which it is derived. What a difference we find between the vegetation of now and then. Plants which now rarely exceed a height of a few inches frequently attained a height of 40 or 50 feet, and a width at the base of from 7 to 10 feet, and in describing the vegetation as a giant one, we are apt to think that geological writers have hit on a most fitting title. There can be no doubt that the climate which existed at that time was one in every way suited for the rapid growth and decay of vegetation, being, not as many writers describe it, "truly tropical," but rather one in which we had no extremes of heat and cold, but one steady warm temperature the whole of the year round. Such an atmosphere as this saturated with moisture is in all probability the truest idea we can get of the coal climate, and those of my readers who have been in large conservatories, will have noticed how under similar conditions vegetation flourishes.

(*To be continued.*)

## IMPORTANT EXPERIMENTS WITH COAL DUST,

BY

HENRY HALL, Esq., H.M.I.M.

In order to determine thoroughly whether coal dust of itself is sufficient to cause an explosion, Henry Hall, Esq., one of Her Majesty's Inspectors of Mines, has for some time past conducted numerous experiments, and has arrived at the following conclusions after detailed observations :—

1. That the flame from a blowing-out gunpowder shot in the presence of dry coal dust always ignites more or less of such dust, and so increases the burning and charring effects of the shot. This is proved by the fact than in almost every experimer which did not result in an actual explosi of dust there was, nevertheless, sev charring of the electric firing cable for seve

yards up the shaft, whilst without dust, and with a similar charge of explosive, no such charring occurred.

2. That when a large flame, such as that of a blown out gunpowder shot, or the flame from the ignition of a small quantity of fire damp, traverses an atmosphere containing a very moderate quantity of dry coal dust, the dusty atmosphere will explode with great violence, and the explosion will "continue on" and pass throughout any length of such atmosphere, its violence and force increasing as it progresses. This is proved by the fact that in nearly every case where the cannon was fired whilst there was dust suspended in the atmosphere of the shaft a violent explosion followed, the force of which was evidently only beginning to be developed as it reached the top of the shaft, and escaped, spending itself in the outside air, the flame in some cases attaining the height of 70 feet over the top of the shaft. It is true there were exceptions to this rule, as in the cases of samples received from the Forest of Dean, Somerset, South Stafford (Great Fenton and West Cannock), Lancashire (Moston), and South Wales anthracite. The difference in the results from these dusts was, I think, due to some difference in the character of the coal seams in those districts. There were also partial failures with the samples from Auckland Park and Trindon Grange, (Durham), and from Talk-o'-th'-Hill, Astley, and Tyldesley, and Llanerch, but in these latter cases I am satisfied that a little more perseverance with the tests, and a more careful collection of the samples, would have resulted in explosions.

3. That coal dust from several seams in different districts, notably those from Glamorgan, Monmouth, Durham, Lancashire, Yorkshire, and Scotland, are almost as sensitive to explosion as gunpowder itself.

4. That coal dust is as a rule more sensitive to explosion in proportion to its high quality and freedom from impurities.

5. That a ready supply of oxygen, such as is supplied by a brisk ventilation, has the effect of making coal dust explosions more probable and more severe.

6. That certain "high explosives" are incapable of igniting or exploding coal dust. Charges of roburite, and in two or three cases ammonite, were fired without effect.

Of all the samples tested, that from the Albion Colliery, Glamorgan, excelled all others in sensitiveness to explosion, and this seam has the worst history of any in the kingdom—more than 1,600 persons have been killed in it since 1846. Nearly all the sweeping and disastrous colliery explosions, too, have happened in seams producing the highest class of fuel—in Durham, the Hutton seam; in Yorkshire, the Barnsley and Silkstone seams; in Lancashire, the Arley seam; and in South Wales, the Aberdare 4ft. and black veins. Accordingly it was the dust of these seams which gave the most emphatic results.

I have again to urge the total abolition of gunpowder from coal mines and the substitution of certain "high explosives." Many of the largest firms in the country have already taken this step. Mines which are naturally of a dry and dusty character cannot be artifically damped so as to render gunpowder safe, but it is nevertheless imperative, in the absence of gunpowder, that every possible effort should be made, either by watering or removing, to avoid accumulations of dry dust. During the last 20 years an average of 20 persons per annum, or a total of 400 lives, have been sacrificed in the handling alone of gunpowder cartridges, that is, through accidental ignitions by stemming, drilling out, or setting gunpowder alight by candle sparks, quite apart from the part it has played in nearly all great colliery explosions. The loss of life from explosions during the past 20 years amounts to 4,098, and it will be much below the mark to say that gunpowder is accountable for 50 per cent. of these explosions, or a total death-roll of 2,049 persons. It is deserving of consideration and experiment to test whether a coal dust explosion would be stopped in its course by a certain length of roadway being constantly kept in a wet condition. Personally, I think such a plan would not prove effective, in consequence of what may be termed the pioneering cloud of dust which precedes the flame, and also in consequence of the great explosive force developed by a coal dust explosion. In three or four experiments the remnants of dust left in the shaft after an explosion proved sufficient to cause a second explosion.

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Apropos of the above we may refer to the explosion which occurred a short time ago at Cameron Colliery, near Radstock, upon which Joseph Martin, Esq., H.M.I.M., was instructed by the Home Secretary to make a special report. His report has now been handed in and investigations tend to prove that coal dust alone is sufficient to cause and did cause this explosion, as fire-damp was absolutely unknown at the colliery.—Ed.

# HAULAGE.

## Chapter VIII.

*Continued from Number 6.*

### Tail-Rope System.—(Contd.)

ONE of the greatest advantages of the tail-rope system is the facility with which branches can be worked. The branches are worked from the main-rope, and three different methods of connecting the ropes to perform this are employed. At the extremity of each branch road, similar to the main road, a return wheel or sheave is fixed, round which the rope passes, and its two ends extend to the main road.

In the method shown by Fig. 1, a wheel is placed near the roof, or under the rails on the main road, opposite the branch road. The rope

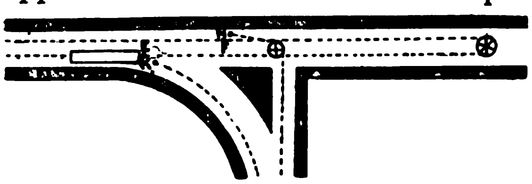


Fig 1

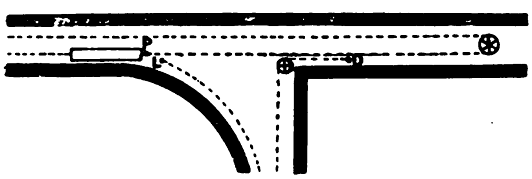


Fig 2

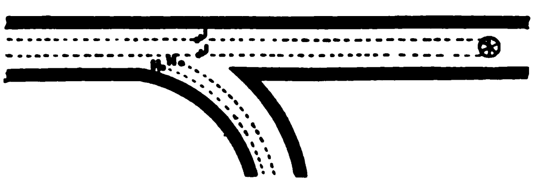


Fig 3

(N) from the branch road is brought round this into the position shown, and the other end of the rope (K) is *brought* along the road on the other side of the triangular pillar, and left in readiness. Now, when it is required to send a train of empty tubs into the branch road, the train is hauled to the point shown by the main road tail-rope. The rope K from the branch road replaces E at the end of the train, and the other end of the branch-rope N replaces F on the tail-rope, a shackle having been left in the tail-rope for this purpose. The train is then pulled into the branch road, the full train drawn back to the main road again, and the ropes again exchanged.

In the arrangement shown by Fig. 2, the branch-rope L replaces P. The end (P) of the tail-rope is then drawn a little in-bye by the engine and connected to D.

In the third method, as shown by Fig. 3, two shackles are fitted in the main tail-rope in such a position that when the full train is at the shaft both shackles (JJ) are opposite the branch road. The two ends (HH) of the branch rope are then changed to JJ, and the empty train is brought along the main road and along the branch road. The shackle generally used for quickly effecting these changes is shown by Fig. 4; the cotter being withdrawn by means of a suitable key with which the attendant is provided.

In order to keep the rope tight in the first arrangement so as to allow of the connection, it is necessary to clamp it until it is connected by means of a winch used for this purpose, the tightening arrangement consisting of a screw worked by a handle.

Fig. 5 illustrates the working of the main-and-tail-rope system, with several branches.

The main haulage way is represented by the downbrow direct from the pit shaft, and in this road there are two junctions at A and B to work the four branch levels. It must of course be understood that the sketch is not drawn to scale, but for the intention of illustrating the principle of the working of the branches. The main road itself is worked in the ordinary manner, and the ropes for this road are represented in sketch by a dot and a line, thus: — - — - —. Now, we will assume that a train of tubs has been hauled from the main road (the in-bye extremity of which is not shown) and has arrived at the pit. When the ropes are in this position uncoupling shackles (which are fitted in the ropes direct from the drum) are in each rope at both junctions. Thus, at the junction A there are two shackles (TT), and at the junction (B) there are two other shackles (HH), and this is always the case when the train is at the shaft. We will next assume that a train is ready at the in-bye extremity of No. 2 South Level, and the attendant at the junction B has been signalled to this effect. Then, while the train of tubs is being changed at the shaft the attendant uncouples the shackles (HH), and to that portion of the ropes in connection with the drums he attaches the extremities (DD) of the rope which lies along the No. 2 South Level, and which passes round the wheel at the extremity. That portion of the tail-rope of this level which runs on the pulleys at the side of the road passes round the wheel shown at the junction (B), and its extremity (D) lies in the

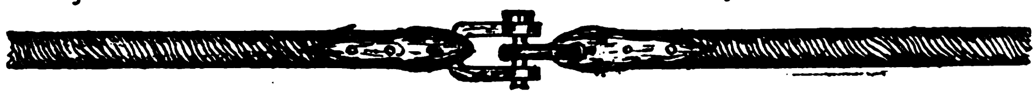


Fig. 4

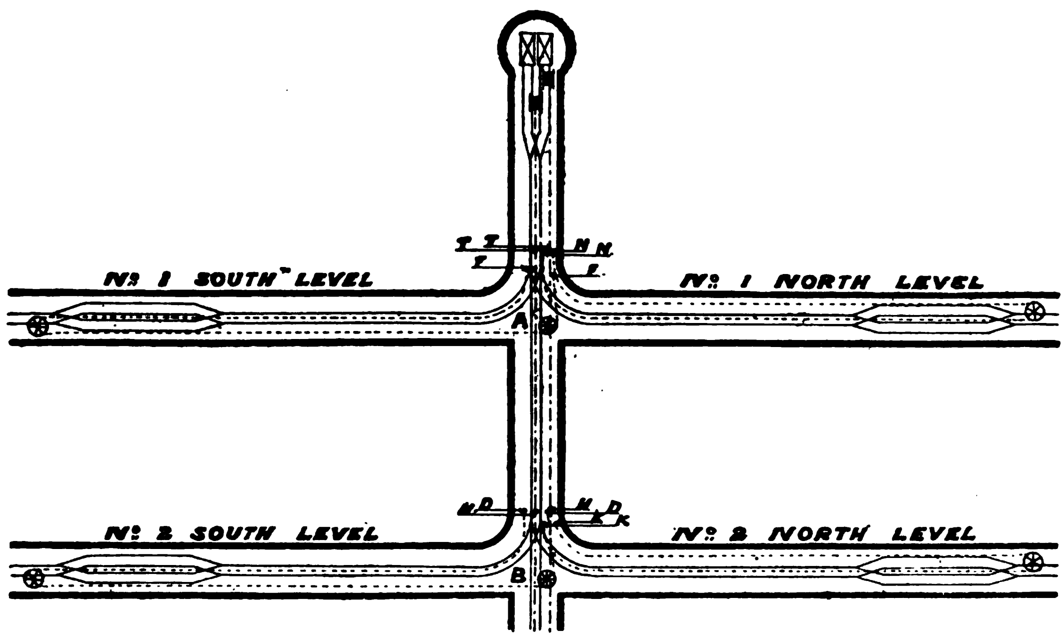



Fig. 5.

position shown until it is required to be attached to the shackle (H). Now, granting that the shackles are coupled as previously mentioned, a little reflection will enable the reader to understand that a continuous tail-rope now extends from the tail-rope drum along the down-brow plane to the junction (B), round the wheel at the end of the No. 2 South Level, and back to the in-bye end of the empty train of tubs which have been prepared at the shaft, the main rope being attached to the other end. The empty train is then drawn into the No. 2 South Level and changed for the full train, and this is hauled back to the shaft. Possibly the No. 1 North Level is the next station that is ready, and as the shackles (TT and HH) are exactly in the same position as in the first case, namely, near the junctions, all that is required is to uncouple the shackles (TT) and attach the extremities (NN) of the No. 1 North Level rope to the ropes in connection with the drum, as before. Then the empty train is drawn into the level, and the full train sent to the shaft. This is the sole arrangement, no matter which road it is required to haul upon. It will be evident, however, that if the train in the main down-brow is the next ready, it will require two pairs of ropes coupled, namely, those at TT and those at HH. The extremities of the rope for the No. 1 South Level are shown at FF, and the extremities of the rope for the No. 2 North Level by KK. It will thus be seen that any branch may be worked with equal facility. The crowded appearance of the sketch at the junctions may be apt to confuse the reader, yet if he will read the explanation slowly, and remember that no matter from which road the last train came, when it is at the shaft, *i.e.*, when almost all the main rope is on the drum, the shackles of the rope are near the junctions (A and B), and the two ends of the rope belonging to the level which is next required to be worked may be attached to the ropes of the drum. It must also be understood that each branch has its own rope and return wheel, and that when the main down-brow is working the ropes shown by the dotted lines in the levels are inactive. The arrangement of the rails will be understood by reference to the sketch double lines being laid at the extremities of the roads, so that the full trains may be on one line, whilst the empty train is coming in on the other.

*(To be continued.)*

## EXAMINATION QUESTIONS,

**With Answers,**

BY A FIRST-CLASS CERTIFICATED MANAGER.

*Commenced in Number 5, Volume II.*

The following questions were given at the Examination of Candidates for Certificates of Competency, in the Manchester District, December, 1892.

**Mine Gases, Lighting, and Ventilation.**

QUESTION 1.—What horse-power is expended in the ventilation of a mine when the quantity of air passing is 95,000 cubic feet per minute, and the water gauge is 3·75?

ANSWER.—

$$\frac{95000 \times 3{\cdot}75 \times 5{\cdot}2}{33{,}000} = 56{\cdot}13 \text{ h.p. required.}$$

(For our readers the rule to find h.p. expended on ventilation:—Quantity of air passing × height of water gauge × 5·2 ÷ 33000.)

QUESTION 2.—State the benefits derived from splitting the air. Where should the splits be to obtain the greatest advantage, and where should they join again?

Answer.—The benefits derived from splitting the air are:—(1) A larger amount of ventilation obtained for the same amount of power expended. (2) Each district has its own supply of fresh air, rendering it safer and healthier for the workmen. (3) In case an explosion occurred in one of the districts there is a greater probability of less lives being lost. (4) In case the ventilation of one district became impeded by falls of roof, &c., to such an extent that the airways belonging to such district became partially blocked, thereby rendering such part or district dangerous, it does not affect the other districts except beneficially, because, if the ventilation in one district is reduced, the other districts, to a certain extent, will receive some portion of the air which is reduced from that part which is impeded.

The splits should commence and end as near to the pit shaft as practicable in order to obtain the greatest advantage.

Question 3.—After an explosion of firedamp, what gases result?

| | | | |
|---|---|---|---|
| Answer.—Free | Nitrogen | 71·2 | per cent. |
| | Carbonic acid | 9·6 | " |
| | Steam | 19·2 | " |
| | | 100·0 | " |

In round numbers we can say seven parts of nitrogen, one part of carbonic acid gas, and two parts of steam, out of a total of ten parts. Steam, directly after the explosion, condenses, and leaves as a residuum about seven-and-a half parts of nitrogen, and one part of carbonic acid gas, out of eight-and-a-half parts, the whole being unfit to breathe, and incapable of supporting either combustion or life.

Question 4.—To what extent will 2,000 volumes of gas expand if the barometric pressure falls from 30·15 to 29·30 inches?

Answer.—$\frac{30{\cdot}15 \times 2000}{29.30} = 2058{\cdot}05$ volumes.

Question 5.—What additional ventilating power would be necessary to double the quantity of air without altering the air-ways?

Answer.—This comes under the third law of the friction of air in mines, viz.:—The power increases or decreases as the cube of velocity. In this case the power required will be eight-fold. $2_3 = 8$.

Take an example. Say velocity in this case is 2, and h.p. expended is 1. What h.p. would be required if the velocity was increased to 4. Therefore $2_3 : 1 :: 4^3$ : h.p. expended, that is 8 : 1 :: 64 : 8 h.p. expended.—Answer.

Question 6.—Show how to ventilate the workings on the annexed plan.

For answer see sketch, &c., in No. 26, Vol. 1, of this paper.

We will commence in next issue with the questions given in the South-Western District (September, 1892), for Mine Managers' First-Class Certificates. The answers to same will be given by Joseph Carter, First-Class Certificated Manager.

## PRIZE COMPETITION.

### QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

1st—All envelopes must be marked "Competition."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by March 17th, 1894.

### ELEMENTARY.

*Question* 1.—Describe the method of measuring air with anemometer and with powder smoke. Which is the best? How many cubic feet of air are there in a current having a velocity of 127 feet per minute in a drift 6 feet 2 inches high by 7 feet 6 inches wide?

*Question* 2.—Describe some of the various methods of preserving timber for underground use, comparing their relative efficiency.

*Question* 3.—Describe, with sketch, the construction of a dam to keep back water.

### ADVANCED.

*Question* 4.—Describe, with sketch, the *Barnsley* method of working thick seams of coal.

*Question* 5.—If a pumping engine, with a 17-inch set, 5-feet stroke, going 3 strokes per minute, and working 11 hours a day, can clear a mine of water in 4 days, in how many days will an engine working a 13-inch set, 4-feet stroke, going 7 strokes per minute, and working 19 hours a day, do the same work?

*Question* 6.—State the various methods of raising water from mines. Describe the safest and most approved kind of pumping engine for that purpose.

### FIRST-CLASS.

*Question* 7.—Describe and illustrate by any sketches you may deem necessary, how you would support an excavation preparatory to building a rather large arch, and state how you would proceed with the brick-work. Describe also the manner in which the excavation is cut or driven.

*Question* 8.—What precautions should be adopted where candles and safety lamps are used in different parts of the same mine?

*Question* 9.—The workings in a four-feet seam of coal approach an extensive waste, containing water, with a head of 40 fathoms which has to be drained. Show, by sketch, and describe how you would tap the waste, and provide that the flow of water would not exceed the pumping capacity of the pit.

*Questian* 10.—Describe efficient methods of attaching flat and round wire ropes to drums and to cages, and the proper measures to be taken for preserving and ensuring the safety of wire ropes.

(It would be as well to notify all competitors to put their answers briefly, and to the point in question, as a great many ramble too far away from the subject.)



All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

## ANSWERS TO QUESTIC

**In No. 6, Vol. 2.**

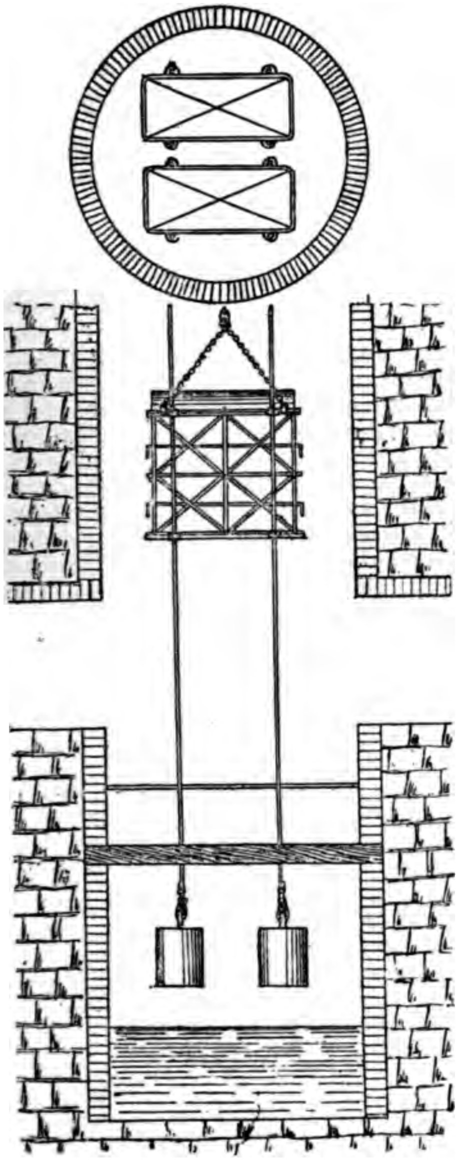
*Question* 1 (E.)—How much coal mig expected to be available in an area o acres of a four-foot seam, allowing one for faults and waste?

*Answer.*—150 × 4840 = 726000 sq. y and 726000 × 9 = 6534000 sq. feet, 6534000 × 4 = 26136000 cubic feet. A foot of distilled water at 62 degrees F. w 62·5 pounds, and taking the specific gr of the coal at 1·26, one cubic foot of coa weigh 62·5 × 1·26 = 78·75 pounds. allowing ⅕th for faults and waste, we fin weight of one cubic foot of coal to be $\frac{78{\cdot}75}{5}$ 63 pounds. Now, if we multiply the feet by 63 we shall get the amount (in po of coal available. Thus, 26136000 × 1646568000 pounds, and this, divided b number of pounds in one ton, will giv amount in tons. Thus, $\frac{1646468 00}{2240}$ 735075 tons.

THOMAS FOX,
14, North-St., Fernda
near Pontyp

*Question* 2 (E.)—Give an account, some illustrative details, of a vertical with wire rope guides.

*Answer.*—Flexible or wire rope guide now being largely employed for condu cages in their ascent and descent in shafts are found to be most serviceable, especia the high velocities which are now attain winding. They consist of wire ropes w are passed through a hole in a beam nea top of the headgear, and secured at th side of this by means of strong wrought clams which grip the rope tightly and them suspended in the shaft, the numb clams varying according to the depth o shaft. The bottom of the conductors passed through beams in the sump, and kept tight and free from vibration by m of heavy weights which are hung on to the of them. Sufficient clearance should allowed to prevent the weights from re on the bottom of the sump; also, bet the cages a clearance of from 12 to 18 in should be left. The cages are provided slide boxes at the top and bottom which



round the guides. Two, three, and sometimes four conductors are used to each cage. In very deep shafts it is often advisable to fix two conductors between the cages to prevent them from coming into collision with each other by oscillation.

W. H. HARDY,
37, Princes Street,
Eastwood, Notts.

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*Question* 3 (E.)—What minerals are usually found in stratified deposits?

*Answer*.—Coal is chiefly found in that group of rocks or formation called the carboniferous formation, and in that portion of it known as the coal measures. Hematite ore is found as stratified ironstone in the limestone measures as in Weardale; clay-band ironstone in the coal measures in Scotland; spathose, or spathic iron ore, as in the middle lines in Cleveland; rock salt in the trias, as at Middlesboro'; rock salt in the permian formation, as in Cheshire; and graphite in the silurian rocks, as in Cumberland. The following are also found in stratified deposits:—copper, mercury, manganese and lead. Cinnabar, or mercuric sulphide, is found in Spain and California. The clay ironstone of the carboniferous formation is truly stratified, as also is the black band ironstone of Central Scotland, and the ironstone of Cleveland. Argentiferous galena, or silver lead ore, is found in well-stratified deposits in the ancient Cambrian rocks of Carnarvonshire. Native copper is found in Bolivia, interspersed through stratified sandstone, and is termed copper burilla.

MATTHEW MOURLEY,
Rock Terrace,
Soothill Lane,
Batley, Yorks.

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*Question* 4 (A)—What observations are required in order to determine the mechanical efficiency of the method employed in ventilating a mine?

*Answer*.—To test a fan's efficiency we must first determine the amount of pressure the water gauge indicates. Suppose it reads three inches. An inch water gauge equals a pressure of 5·2 pounds per square foot. Then, three inches equals 15·6 pounds on the square foot. Now, let the sectional area of the main in-take airway be equal to 100 feet, and let the velocity be 20 feet per second. Then, 100 feet × 20 feet × 60 = 120000 cubic feet of air per minute, therefore $\frac{120000 \times 15{\cdot}6}{33{,}000} =$ 57 h.p. nearly. The useful effect or efficiency of a fan is the proportion which the ventilating power produced bears to the power of the engine. For example, suppose a fan engine generates 120 h.p., and suppose the fan produces, as above, 57 h.p. of ventilation. Then as 120 is to 57 so is 100 to 47·5, which is the useful effect or efficiency of the fan, namely 47·5 per cent. of useful effect.

GEORGE DAYKIN,
24, High Gurney Villa,
Bishop Auckland.

*Question* 5 (A.)—At what rate will it be necessary to work a 12-inch pump of 9 feet stroke to keep a flow of 200 gallons of water per minute, in a shaft 200 yards deep, and what approximate H. P. will be requisite?

*Answer.*—First find what the pump barrel holds. $12 \times 12 \times 9 \times \cdot 034 = 44 \cdot 064$ gallons in pump barrel. Then, divide the flow. $\frac{200}{44 \cdot 064} = 4 \cdot 538$ rate of strokes per minute.

The h.p. is found as follows:—

$$\frac{200 \text{ gallons} \times 10 \text{ lbs.} \times 200 \text{ yards} \times 3 \text{ feet}}{33000 \times \cdot 5} =$$

$\frac{1200000}{33000 \times \cdot 5} = 72 \cdot 72$ h.p. For pumps, a modulus of $\cdot 5$ is chiefly used.

THOMAS SMITH,
Kebblesworth,
Gateshead.

*Question* 6 (A.)—What construction of screen is best adapted to prevent breakage of coal in screening?

*Answer.*—The best class of screen for preventing the breakage of coal is what is known as the jigger screen, with the tippler working inwardly. The tub having been run on to the tippler, which consists of a kind of cage turning on friction rollers, it is liberated by means of pulling a lever, when the tub turns partly round in the direction against the slope of the screen. Consequently, the coal comes in contact with the bars or network (which is preferable) of the screen with not more than a few inches fall, thereby causing less breakage of coal. The screen consists of strong wire meshes, which in themselves are a great improvement over the ordinary iron bars of the old-fashioned screens. The wire network gives way as the coal comes in contact with it, and thus causes less damage to the coal. A small engine is employed to work the screens. By means of a double eccentric a backward and forward motion is given to them, the forward motion of the upper screen coinciding with the backward motion of the lower one, causing the coals not to have such a large amount of throw—in fact, the amount of throw is reduced to almost a minimum. The coal from the upper jig passes on to the under jig, and in such a manner that three wagons can be in filling at one and the same time with round, cobbles, and slack.

WILL ATHERTON,
236, Woodhouse Lane,
Wigan.

*Question* 7 (H.)—When a coal seam is on fire how should it be isolated to prevent the fire from spreading to other parts of the workings?

*Answer.*—By sand dams or stoppings. I should first select the most suitable place for putting in the stoppings, but as near the seat of the fire as possible. In selecting these places I should take into consideration the number of stoppings required, as the fewer the stoppings the more complete the sealing-off will be. In selecting a place for a stopping the roof and sides should be solid, and of as small sectional area as possible. In arranging for the stoppings I should prepare and put them in as nearly as possible at one time, except at the point at which the in-take air enters. I should first seal off the stopping where the return air comes out, then follow-up sealing the intermediate stoppings between that and the in-take. In no case would I seal off the in-take stopping first, as in most cases it would be impossible to approach the return airway stopping for the smoke and gases given off by the fire; the fire would also spread more rapidly, and the gases would expand. Under these circumstances there would be a partial vacuum formed in the workings thus sealed off, and most certainly any flame given off from the fire coming in contact with the gas would cause an explosion. If, however, the stopping in the return airway is built up first the order of things is reversed, that is to say, the smoke and fumes given off from the fire are held under a partial pressure. The smoke would then act somewhat as an extincteur upon the fire, and any explosive gas present would become non-explosive, and allow sufficient time to seal up the stopping in the intake. which could be performed in fresh air.

GEORGE DEVERILL,
No. 6, Bride Place,
Hempshill Lane,
Bulwell, Nottingham.

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*Question* 8 (H.)—Describe, with sketch, a form of percussive boring machine.

No suitable answer received.—ED.

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*Question* 9 (M.)—Describe the best kind of boiler for the safe and economical generation of steam, at high pressure, for colliery engines. Give a description of the mountings or fittings necessary for safe working.

*Answer.*—The advantages and economy of using steam expansively, and consequently at high pressure, is now generally known. The best kind of boiler and the boiler which will generate steam at the least cost, and with the greatest amount of safety is the Lancashire boiler with galloway tubes. Lancashire boilers are usually about 28 feet long and 7 feet diameter. The horse-power of a Lancashire boiler of the above dimensions would be found by multiplying the length by the diameter and dividing by three. Thus,

$$\frac{28 \times 7}{3} = 65 \text{ h.p.}$$

Fittings or mountings necessary for safe working:—There should be two safety valves, one being the weighted lever form, and the other Hopkinson's dead-weight safety valve, to prevent over-pressure; two water gauge glasses in front of the boiler, so as to be under the eye of the stoker; and a water float to indicate the height of water in the boiler. The float should be so constructed as to communicate with and blow a whistle when the water gets below the working level, so as to call the attention of the person in charge. A pressure gauge to indicate the pressure; a fusible plug to let off the steam and water, which melts when the pipes get overheated; a feed pipe, terminating within a few inches of the bottom of the boiler, with a rose mouth turned upwards; a man-hole to admit of the boiler cleaner, inspector or repairer; a sludge valve for sludging the boiler; and an anti-priming valve to prevent priming. All valves, gauges and other safety appliances should be carefully inspected and worked each day or more, to ensure their safe working.

WILL. LITTLER,
234, Woodhouse Lane,
Wigan.

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*Question* 10 (M.)—Granting that a boy has every opportunity, what course do you consider the best for him to adopt to become an efficient colliery manager?

*Answer.*—The boy, after receiving a good education, should go through the following subjects:—The practical working of mines (to be learned in the mine), the management of the workmen underground, the principle of machinery, Coal Mines Regulation Act, 1887, principles of ventilation, methods of boring, sinking, tunnelling, and the laying down of plant for the beneficial working of a colliery, steam and the steam engine, machine construction, drawing and surveying, and he should have the practical experience of working in mines, and different methods of working coal to the best advantage, the strength of material used in mines and about machinery, and he should have five or six years' apprenticeship in and about the mine, and he should be a constant reader of the valuable paper "Mining."

HERBERT HALL,
15, Yardley Row, Ryhill,
near Wakefield

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## ANSWERS TO CORRESPONDENTS.

R.A.—The answer to question 4 of No. 5 issue should be 9642 tons, 3 cwt., 3 qrs. nearly, instead of 9642 tons, 2 cwt., 3 qrs., nearly. This 1 cwt. is a misprint, and has been overlooked in the proof, because the answer when exprssed in tons and decimal, a ton is 9642·1869 which = 9642 tons, 3 cwt., 3 qrs. nearly. As our correspondent R. A. refers to his answer, we are sorry to inform him that in looking over his paper we find he gives 96421·875 tons, although the one he sends now is different (9642·1875), therefore we cannot see how he can bring this to 9642 tons, 3 cwt., 3 qrs. It is quite evident that he must have overlooked this error and through an oversight placed this decimal in the wrong place, which several others did the same way to this answer. Thanking him. all the same for pointing out the error.

The Barometer.—In reply to "Anxious Barnsley Student's" question, an approximate rule to find height of barometer for given depths is to add $\frac{1}{10}$th of an inch for every 90 feet in depth.

Example.—The barometer on surface reads 28·5; what will it read at the following depths: 100 fathoms and 250 fathoms?

I.—100 fathoms = 600 ft., then $\frac{600}{90 \times 10} =$ ·666 increased height of barometer. Therefore 28·5 + ·666 = 29·166 height of barometer.

II.—250 fathoms = 1500. You can either find this by simple proportion, or as above. 600 : ·666 :: 1500 : 1·666. Height of barometer at this depth would be 28·5 + 1·666 = 30·166. Rule, $28{\cdot}5 + \frac{1500}{90 \times 10} = 30{\cdot}166$.

F.A.R.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### "The Colliery Fireman."

Barnsley.

*To the Editor of "Mining."*

Dear Sir,

I have been a reader of your paper for nearly twelve months, yet this is the first time I have taken the opportunity of corresponding with you.

I wish to add my testimony to that already given by some of your correspondents, to the effect that there are many colliery officials in this district who cannot read or write. Some managers have a reason for keeping such men, as they are aware that they are not competent in themselves, and are afraid of having their situations taken by competent men. I am in favour of having an examination which must be passed prior to becoming a fireman. If such a course was adopted many men now acting as firemen would go to their proper places as datallers. Just a word respecting your Journal. I think it is just the thing for mining students. I have passed two exams., and have received considerable help from reading it. Yours, "Rockingham."

(With reference to the above subject we think we can now close this correspondence, as all our readers seem to arrive at the one conclusion, viz.:— that incompetent persons are at present employed as firemen, and the general opinion is in favour of an examination for firemen as there is for colliery managers and under-managers. We hope that this will be effected at an early period, as it is a shame that ignorant men should hold such a responsible office.—Editor of Mining.)

### "Climax" Grip Pulley.

Market Chambers,
Heckmondwike.

*To the Editor of "Mining."*

Dear Sir,

I notice in your No. 6 issue that Mr. Jesse Hartshorne writes disparagingly of the working of the pullies at the collieries of Rhodes, Wright & Wroe, Limited, Heckmondwike, and perhaps you will allow me to reply. These pullies had been in use at these collieries over six years previous to your correspondent's appointment, and they had worked very successfully, but had to be dispensed with to make room for such as Mr. Hartshorn had been accustomed to.

Yours faithfully,

J. Dearden.

### Sinking through Quicksand.

*To the Editor of "Mining."*

Dear Sir,

Will some of your readers kindly answer the following question, and oblige?

In sinking a shaft down several fathoms through hard rock a bed of quicksand is struck, of several feet in thickness, and it is decided to sink through the sand by pile driving. In what way can the shaft be sunk so as to keep it of the required dimensions to allow of walling outside the piles, as each series of piles will diminish the size of the shaft?

Yours truly,

"Sinker."

### Examinations for Certificates.

*To the Editor of "Mining."*

Dear Sir,

Allow me, through your Journal, to say a few words with reference to the time allowed to complete the papers at the above Examinations. In some cases it is barely sufficient to enable a rapid writer to answer the whole of the questions, then poor indeed must be the lot of the slow writer. Now, what I wish to know is, does the fact of a person being a slow writer render him incapable of performing the duties of a colliery manager? If so, in what way?

Yours truly,

"Slow Writer."

## NOTICE TO READERS.

*Information for Candidates for Certificates.*

We have been informed that no fee is now required for Certificates as was asserted last issue. We may also state that several letters from correspondents together with the following articles (Mine Surveying, Mining Machinery and Appliances, Glossary, Camm Patent Pick, &c.) have been unavoidably left over through lack of space.

*Printed and* Published by Strowger and Son, Clarence Yard, Wallgate, Wigan.


Vol. II. SATURDAY, MARCH 24, 1894. FORTNIGHTLY ONE PENNY.

## CONTENTS.



# MINING LECTURES

By C. LATHAM,

cturer to the County Council and University of Notts.

*(Specially written for this Journal.)*

Commenced in No. 8, Vol. II.

No. 1 CONTINUED.

RHAPS the plants which contributed individually more than any other towards production of coal was what we know as Sigillaria. This plant, in the writer's ion, was the olden time representative ne of our present club mosses, and if we a moment contrast the size of the two, are able to form some idea of the very t changes which have taken place in the etable kingdom.

n some tropical regions the club moss grow to a height of from 12 to 18 inches even more, but in England it rarely eeds 2 or 3 inches. Now, turning to the llaria, we read of one specimen being d 72 feet in length and 8 feet broad at base, and, moreover, this is by no means solated case, frequently we find it from 50 to 60 feet long and broad in proportion. Of the kind of leaf of this plant we know little or nothing, but the nature of the root has been very clearly demonstrated, it is known as Stigmaria.

Sigillaria.

Stigmaria.

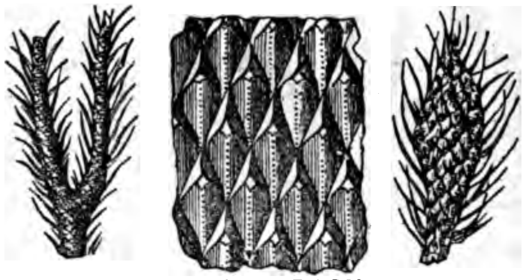
The science of geology has given us many important facts, and by so doing clearly established truths, which otherwise would have been hard to prove.

The discovery that Stigmaria was the root of the Sigillaria, and not as was commonly thought a separate plant, has proved of the very greatest importance in enabling us to account satisfactorily for the formation of coal. In fact it is hard to imagine how, without this one connecting link, we could have arrived at much of our present day knowledge of the coal plants.

Another plant abundant in coal is the Lepidodendron, not unlike our fir trees in its appearance, but having a present day representative not in the fir, but in one of the small club mosses.

The Lepidodendron grew to a height of about 40 feet and broad in proportion, and although at first sight it looks very similar

to the Sigillaria, on close examination we find a very marked difference, a difference which to the most uneducated eyes is plainly and easily apparent.

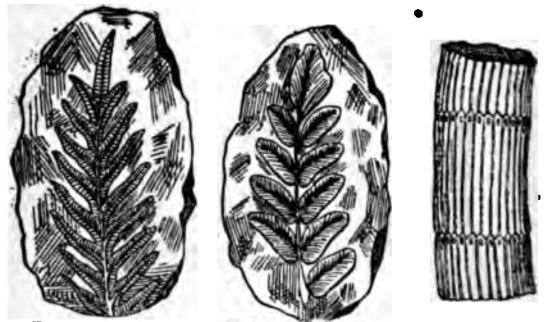


**LEPIDODENDRON.**
**Branch.** **Bark.** **Fruit.**

The Calamite is possibly the most familiar plant of the coal period, it is well represented by what we know as the horse-tail, that small plant which is usually found growing abundantly round the edges of shallow ponds.

The Calamite grew to a height of about 20 feet, and here again we have an illustration of the marked difference in size then and now. The fruit of this plant was not unlike what we know as the fir cone, and possibly many of the seeds we are able to distinguish in coal under the miscroscope belong to the plant. In addition to the plant we have mentioned there are no doubt many others each of more or less importance, but at the same time not of sufficient moment to need a special description, and we pass along to consider some of the ferns which assisted in the making of our black diamond. It is to be remarked, however, that we know little of the habits of the ferns of the coal period, whether they grew out of the ground or attached to the stems of trees, but it is generally assumed that they took the form of what we know as the fern tree.

The Pecopteris and Neuropteris were possibly the most abundant ferns, and in fact in almost every mine we frequently come across these plants in the "fossil" state. The ferns now living in this country, of which I believe there are about 90 species, form only a very small proportion of those existing during the coal period. The reason why we are only able to distinguish so few specimens of the fern in coal, being no doubt due to the rapid distinction which ferns undergo when put into water, and hence only the most hardy remain to reward our industry.



**Pecopteris.** **Neuropteris.** **Calamite.**

To the seed of the fern is largely due the bituminous character of some coal compared with the non-bituminous character of others in which fern life has existed only to a very small extent, the greater the number of ferns the greater the quantity of seeds, and hence the larger amount of bituminous matter.

To those of my readers who would like to study in detail the various characteristics of the coal plants, I would advice some text book on geology, and in so doing I feel quite sure they would not only reap valuable information, but at the same time find the study most interesting.

### The Formation of Coal.

We must now attempt to trace the causes which have led to the conversion of the ancient vegetable growth into the hard, black coal seams we are now extracting from the bowels of the earth, and in order to do so, in as clear a manner as possible, we require to turn our attention to three points, namely :—

1st. How did the vegetable matter grow.

2nd. How did it become embedded in the earth, and

3rd. How did it become coal.

In order to account for the formation of a coal seam we find different writers hold different views, in fact we possess two distinct and separate theories, the first being that the vegetable matter now forming coal was washed down by brooks and rivers into lakes and seas, where becoming water-logged it sank to the bottom and in time became converted into coal, this is known as the deposit theory.

The second, which is known as the growth *in situ* theory, says that the vegetable matter now forming coal grew on the land where we now find it transformed into coal.

Having got so far let us now examine each theory in the order we have named and try and sift out for ourselves the various proofs and arguments for and against. Before doing so I must say, however, that to my mind the first theory is a very far-fetched one and in every way utterly inadequate to account for the coal formation. There may, however, have been some "masses" of coal, one cannot call them seams, of a very poor and inferior kind which originated by this theory, but the formation of a true coal bed is an impossibility.

In proof of this what arguments can we bring forward—any in favour of this theory? I say no. Can we bring any against it? Yes. And each one not only an argument against it, but further an argument in support of the second theory. Moreover can we show any facts bearing out this deposit theory? No. Can we show any bearing out the *in situ* theory? Yes.

(*To be continued.*)

## EASY LESSONS ON MINE SURVEYING

**For Beginners.**

*Commenced in No. 2, Volume II.*

### MENSURATION.—(Contd.)

Prob. V.—Having the three sides of any triangle given, to find its area.

Find half the sum of the sides, and also the difference between this number and each of the sides; then find the continued product of the half sum, and the three differences and the square root of the product will be the area.

Example.—Given the side AB (Fig. 48) = 9·2, BC = 7·5, and AC = 5·5; required the area of the triangle.

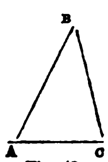


Fig. 48.

9·2 + 7·5 + 5·5 = 22·2 sum.

One-half sum: 11·1 — 9·2 = 1·9
11·1 — 7·5 = 3·6
11·1 — 5·5 = 5·6

then $\sqrt{(11{\cdot}1 \times 1{\cdot}9 \times 3{\cdot}6 \times 5{\cdot}6)} = \sqrt{425{\cdot}1744} =$ 20·619 the area of the triangle.

Prob. VI.—Give any two sides of a right-angled triangle, to find the third side, and thence its area.

First find that third side by rule:—Hyp.$^2$ = sum of squares of two other sides; and then proceed as in previous problem.

Prob. VII.—To find the area of a trapezoid.

Multiply half of the sum of the two parallel sides by the perpendicular distance between them, and the product will be the area.

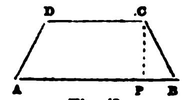


Fig. 49.

Example.—Let A B C D (Fig. 49) be a trapezoid. The side AB = 40, DC = 25, and CP = 18; required the area. 40 + 25 = 65 ÷ 2 = 32·5 × 18 = 585 area.

Prob. VIII.—To find the area of any quadrilateral.

Divide the quadrilateral into triangles, find the area of these figures, and the sum of the areas will be the area of the figure.

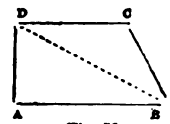


Fig. 50.

Example.—Let A B C D (Fig. 50) be a quadrilateral: required the area. Given AB = 548 links, AD = 715 links, CD = 751 links, BC = 821 links, and the diagonal DB is measured and found to be 967 links. By Prob. 5 find the area of each triangle, and add these areas together for the answer.

4 acres, 3 roods, 27·67 poles.—Ans.

Prob. IX.—To find the area of a quadrilateral when one of its diagonals and the perpendiculars on it from the opposite angles are given.

Multiply the diagonal by the sum of the perpendiculars, and half the product is the area.

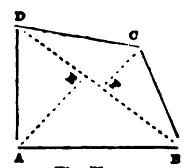


Fig. 51.

Example.—How many sq. links in a quadrilateral field ABCD, a diagonal (DB) of which is 1245 links, and the perpendiculars (AE and CF) are 675 and 450 links respectively.

$\frac{1}{2} \times 1245(675+450) = \frac{1}{2} \times 1245 \times 1125 =$ 700312·5 sq. links, or 7ac., ords., 0·5pls.

Prob. X.—Given the diameter of a circle, to find the circumference, or the circumference to find the diameter.

(1) The diameter multiplied by $\frac{22}{7}$ = the circumference; or (2) the diameter multiplied by 3·1416 = the circumference.

Example 1.—The diameter of a circle is 15, what is its circumference? $15 \times \frac{22}{7} = \frac{330}{7} = 47{\cdot}142$; or, $15 \times 3{\cdot}1416 = 47{\cdot}124$.

(NOTE.—The second rule, viz.:—Multiply by 3·1416 is the most correct, but for rough calculations $\frac{22}{7}$ may be used.)

Example 2.—The circumference of a circle is 80, what is its diameter? $80 \times \frac{7}{22} = \frac{560}{22} = 25{\cdot}45$; or, $\frac{80}{3{\cdot}1416} = 25{\cdot}46$.

Prob. XI.—To find the area of a circle.

(1) $\frac{\text{Diameter}}{2} \times \frac{\text{Circumference}}{2} = \text{area}.$

(2) Diameter squared × ·7854 = area.

Example.—To find the area of a circle whose diameter is 100, and circumference 314·16.

By (1)—314·16
100
4) 31416
7854 Area.

By (2)—$100^2$ = 10000
·7854
Area 7854

Prob. XII.—To find the area of a circular ring, or of the space included between two concentric circles.

Multiply the sum of the two diameters by their difference, and this product by ·7854.

Example.—Let there be two concentric circles whose diameters are 30 and 20 respectively, what is the area of the ring?

30 30
20 20
50 × 10 = 500 × ·7854 =
392·7 area of ring.

(There may be some of the above which those readers who have not followed the articles from the beginning may not understand, so we herewith give the previous numbers in which these articles have appeared:—Nos. 2, 3, 4, 5 and 7, Vol. II.)

Questions on the Lesson.

(1) How many square feet in a triangle whose three sides are 13, 14, and 15 feet?

Ans.—84 square feet.

(2) Find the area of a trapezoid whose parallel sides are 30 and 40 feet, and perpendicular breadth 15 feet.

Ans.—525 square feet.

(3) In Fig. 51 let DB equal 100, AE equal 35, and FC equal 30; What is the area of the figure?

Ans.—3250.

(4) What is the diameter of a circle, whose circumference is 50?

Ans.—15·909.

(5) The circumference of a circle is 91; what is its area?

Ans.—659·00198.

(6) The inside diameter of the brickwork of a shaft is 10 feet, and the outside 12 feet. What is the area of the brickwork?

Ans.—34·558.

*CORRECTION.—In the third question on the lesson in this subject in No. 7, Vol. II, the height of the parallelogram was given as 15 instead of 13. The answer will now be found to be correct.*

(*To be continued.*)

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

### Subject I.—ARITHMETIC.

Question 1.—Find the square root of 572·14096 to three places of decimals.

Answer.— . . . .

2)572·14096 ( 23·919.—*Answer.*
4
43 ) 172
129
469 ) 4314
4221
4781 ) 9309
4781
47829 ) 452860
430461
22399

Question 2.—Reduce $\frac{7{\cdot}75}{9}$ of $\frac{2\frac{1}{2}}{2\frac{7}{9}}$ of $\frac{20}{31}$ to a decimal quantity.

Answer.—

$\frac{7{\cdot}75}{9}$ of $\frac{\frac{5}{2}}{\frac{25}{9}}$ of $\frac{20}{31} = \frac{7{\cdot}75 \times 5 \times 9 \times 20}{9 \times 2 \times 25 \times 31} = \frac{1}{2} =$

·5.—*Answer.*

Question 3.—A tank built to the form of an octagon is six feet deep, and each side is seven feet long. These are inside measurements. How many cubic feet of water will the tank hold?

**Answer.**—To find the cubical contents of a regular octagon we must first find the area which is most easily done by multiplying the square of one of the sides by the following tabular number:—∴ 4·8284272 × 49 = 236·5929328 area of octagon. Cubical contents = 236·5929328 × 6 = 1419·5575968.

1419·5575968—*Answer.*

Another rule is to construct a regular octagon and the radius of an inscribed circle multiplied by length of one side multiplied by number of sides divided by two, will give the area.

Question 4.—Find, in inches, to three places of decimals, the side of a square which has an area of 41·9 square feet.

Answer.—41·9 × 144 = 6033·6 area in inches, ∴ $\sqrt{6033 \cdot 6}$ = 77·676 length of required side.

Question 5.—The capacity of a chamber is 6548 cubic feet. It is filled with an atmosphere composed by volume as follows:—N, 79·00 per cent.; O, 20·96 per cent.; $CO_2$, 0·04 per cent. What number of cubic feet of each gas is contained in the chamber?

Answer.—Say as 100 is to the volume so is the per cent. to volume required.

1st, N = 100 : 6548 :: 79.00 : 5172·92 volume of N.
2nd, O = 100 : 6548 :: 20·96 : 1372·4608 volume of O.
3rd, $CO^2$ = 100 : 6548 :: 0·04 : 2·6192 volume of $CO_2$.

6548·0000

So that it contains 5172·92 Nitrogen
1372·4608 Oxygen
2·6192 Carbonic acid

6548·0000

Question 6.—A pillar of coal, 150 yards long by 44 yards wide, has been completely worked out and sent to bank. The total weight of the coal is found to be 12·430 tons, and its specific gravity 1·25. What was the thickness of the pillar?

Answer.—$\frac{48 \times 12430}{1 \cdot 25 \times 150 \times 44}$ = 72·32 inches.
72·32 inches ÷ 12 = 6·02 feet; call it

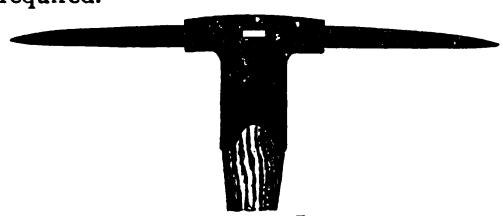
6 feet thick.

*(To be continued.)*

# THE "CAMM" PATENT PICK.

It is our endeavour to submit to our readers all the latest improvements and inventions relating to mining in order that they may judge for themselves as to the benefit or otherwise of the article in question. We are therefore pleased to be able to give illustrations, etc., of the "Camm" Mining Pick. We have seen this pick, but cannot at the present say anything positive as to the advantages which it is said to possess, though we have no doubt it possesses some advantages. The following are those claimed to be possessed by it:—

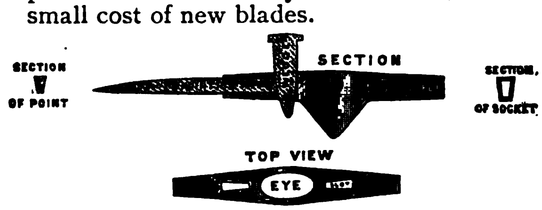
Simplicity.—The pickhead is the same shape as a solid pick, but the eye does not bulge out, and the arms are blunt and hollow. The points or blades are placed in the sockets and are self-tightening on an entirely new principle by the slightest pressure or blow, and work tighter in use. Although marvellously tight, the blades can be instantly released by a very small waistcoat-pocket wedge knocked through the slot in the arm of the pick. No fastening key or wedge is required.



COLLIERS' PATTERN B.

Shaft.—Any shaft may be used. The formation of the eye makes hoops unnecessary and causes a large saving in cost of shafts.

Points or Blades.—These may be replaced instantaneously when worn, at the small cost of new blades.




Durability.—The points or blades are made of steel of superior quality, which is tougher and harder than the soft welding steel which must be used for pointing other picks. They wear ten times longer, and thus save their cost many times over. The pickhead is permanent, exceedingly strong, and will last for years.

WEIGHT TO CARRY.—Only one pick need be taken down the pit, with a few spare blades, which are light and convenient to carry. Only the blades need be brought up again.

SHARPENING.—This can be done by any smith by heating the blades to a worm red and tempering them to a plum colour. Only the blades need be taken instead of the whole pick, but the smith may have a loose pick-head to hold them in instead of tongs.


COLLIERS' PATTERN A.

CONVENIENCE AND COMFORT.—The pick is comfortable to use, gives a clean solid blow, and the weight is so placed that it adds power to the blow. For working where there is not much room, one of the blades can at any time be removed.

SECURITY OF BLADES.—They are as secure as if solid, and when in the pick ring like solid picks. Their self-fastening power astonishes all who try them, and is caused by the shape and trueness of the socket which is dovetailed and tapered and made perfectly true, and by the shanks of blades being made to fit. This shape of socket gives a better bearing than any other shape, viz., three bearings—the greatest number possible—as against two bearings in a square socket.

BALLARAT OR GOLDMINERS' PATTERN D.

TRANSPORT.—Picks and blades can be closely packed for long journeys.

CHEAPNESS.—The first cost is about the same as other patent picks, but, as after the purchase of the pickhead only blades are required, there is a great saving in price as well as in wear. They are therefore cheapest and best.

N.B.—The blades for the 2½lb. A, and 3lb. A picks are interchangeable, fitting either. The 2lb. pick being much smaller, the blades only fit that weight of pick.

B. PATTERN.—The blades are interchangeable, fitting all the weights.

## THE SCIENCE AND ART EXAMINATIONS.

In answer to a Correspondent, we may say that Professor LUPTON's new work on Mining is we deem suitable for the advanced stage of the S. and A. Dep., but as to the book most suitable for the Honours Grade it is impossible to say. The questions given are in many cases so obtuse, and altogether unsuitable for an advanced test examination as this is intended to be, that we entirely despair of any book being published that will fill the want. As an example of this we append below the questions given in the May Examination of 1891.

There are eight questions, six of which you have to answer. Time allowed, three hours.

### HONOURS.

(1) What are the most important districts producing copper ores at the present time? Give details of the nature of the deposits, and the character of the minerals produced in each district.

(2) What are the qualities required in a steam coal for navigation purposes? Where such coals produced in the United Kingdom, and how are they prepared for sale?

(3) Describe some methods of working large mineral deposits where filling or packing with rock is used.

(4) What are the principal air compressors used for mining purposes?

(5) Describe the principal methods used in working deposits of rock salt.

(6) Give an account of some of the principal water-pressure pumping engines at work in deep mines.

(7) What is the Luhrig system of coal washing?

(8) What is the Huntingdon quartz mill, and what advantages are claimed for it over stamps?

How anyone with the slightest knowledge of mining can set such questions as a test is what we fail to comprehend, and the results of the examinations a short time ago afford an incident to support this statement. About six or seven students sat for the examination at one of the centres, and the only one to pass was one who did not work in a mine at all, in fact, we doubt if he had been down a mine half-a-dozen times. However, it would seem that it is useless to grumble as no change has been made for several years, despite constant efforts to effect them. Under the circum-

stances, the best books we can recommend are HUGHE's and PAMELEY's, which, even if they do not enable a student to pass the Honours Grade of the S. and A., will at least do good work in preparing him for a Colliery Manager's Certificate. We therefore advise students to sit for this Examination in the ordinary course, but not to put themselves out of the way in attempting to obtain the Honours Certificate, but, if unsuccessful, to apply themselves for the Colliery Managers' Examinations. In next issue we will give examples of the Advanced Questions.—ED.

## COMPETITION QUESTIONS.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3rd—Correct name and postal address must be sent.

4th—They must reach us by March 31st, 1894.

### ELEMENTARY.

*Question* 1.—Describe the water blast or trompe, and give a sketch showing its mode of action.

*Question* 2.—In what manner can coals be classified according to their relative ages?

*Question* 3.—Describe, with sketch, how you would timber a level in coal with a hard bottom and soft roof.

### ADVANCED.

*Question* 4.—Describe what arrangements are made in the tubing of a shaft to let off any extra pressure of gas or water.

*Question* 5.—How would you ventilate a sinking pit and the shaft bottom under the working scaffold.

*Question* 6.—State what is the chief portion of the carboniferous limestone in relation to the coal measures, and mention an exceptional case in England where a large area of carboniferous limestone is found in connection with the coal measures in a contrary order as to position.

### FIRST-CLASS.

*Question* 7.—Show how you work out the following levels taken off a field book:—

| Back sight. | Fore sight. | Rise. | Fall. | Reduced levels. |
|---|---|---|---|---|
| 11·65 ... | 9·77 | ... | ... | ... |
| 9·77 ... | 4·88 | ... | ... | ... |
| 4·88 ... | 1·94 | ... | ... | ... |
| 1·94 ... | 4·08 | ... | ... | ... |
| 12·05 ... | 5·05 | ... | ... | ... |
| 5·05 ... | 5·72 | ... | ... | ... |
| 5·72 ... | 1·92 | ... | ... | ... |
| 1·92 ... | 2·73 | ... | ... | ... |

*Question* 8.—Enumerate the noxious gases found in collieries, and state the composition of each.

*Question* 9.—A fan engine works at the rate of 80 revolutions per minute. The steam cylinder is 18 inches diameter; the stroke is 30 inches; the mean steam pressure on the piston is 40 pounds per square inch. Work out the theoretical horse-power of this single-cylinder engine.

*Question* 10.—What size of hauling engine would be required to draw 100 tons of coal per hour up an incline of 1000 yards, with a gradient of 1 in 6?

## ANSWERS TO CORRESPONDENTS.

A.H. (Sheffield.)—If the formulæ used is taken from some standard work, we cannot see why the same number of marks should not be obtained although the answers might not be exactly alike, because every experiment taken is not under the same conditions and taken by different men, consequently, the different formulæ for obtaining the result desired varies, and the answers accordingly must differ to the same extent (although each one gives, to the best of their knowledge, such formulæ as they think obtains best and safest results).

We think it advisable that, when at examinations, the author of any formulæ (when used) should be given.

G. GRIFFITHS (Hindley.)—We are obliged for your attracting our attention to the question. See correction under Surveying.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

## ANSWERS TO QUESTIONS

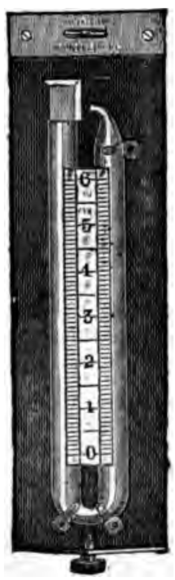
### In No. 7, Vol. 2.

*Question* 1. (E.)—Describe the apparatus used for finding (*a*) the moisture in the air; (*b*) the pressure of air in airways; (*c*) the velocity of air in air-ways, and the principle of action of each.

*Answer.*—(*a*) The Hygrometer is used for finding the moisture in the air, and it consists of a pair of thermometers fixed on two graduated arms of wood. The bulb of one thermometer is continually kept wet by being covered with muslin connected to water by a thread, which acts by capillary action. The water evaporates from the muslin and produces cold, reducing the temperature. The bulb of the other thermometer is in the usual dry state. The difference of the temperature between the two thermometers indicates the dryness of the air. The hygrometer acts on the following principle. The dewpoint of the air is determined, and this being known, it is not difficult to calculate approximately the absolute quantity of moisture in any bulk of air.

(*b*) The pressure of air in airways is found by the Water-gauge. This instrument consists of a glass tube of small diameter, bent into the shape of the letter U and open at

**Anemometer.**



**Water Gauge.**

both ends. Water is poured into the tube so as to fill the bend and rise up a little in each arm, and between these arms a sliding scale is put shewing inches and decimals. When there is a greater pressure on one side than on the other the water rises in the tube of least pressure, and the difference of height of the water in the two tubes is then measured by the scale and is called W.G. From this the ventilating pressure per square foot is calculated.

(*c*) The velocity of air in airways is found by an Anemometer. There are various kinds of this instrument, but the best are those which register the velocity by means of indices which are worked by a small windmill-like wheel, which rotates at a speed per minute in proportion to the velocity of the air which acts upon it.

HUBERT BRADSHAW,
286, Worsley-rd, Swinton,
near Manchester.

*Question* 2. (E.)—What number of bricks are required to line a shaft 14 feet diameter, 120 fathoms deep, and 18-inch wall? (1000 bricks equal three cubic yards.)

*Answer.*—Rule to find the area of the wall? Multiply the sum of the diameter by their difference, and then by ·7854.

Thus, inside dia. = 14 ft. and outside dia. = 17 ft. $\left.\begin{matrix}\\ \\ \end{matrix}\right\}$ = 3 ft. difference.

Therefore, $14 + 17 \times 3 \times \cdot 7854 = 73\cdot 0422$ sq. feet area of wall, and $\frac{73\cdot 0422 \times (120 \times 6)}{27} =$ 1947·792 cubic yards contents of wall. Hence $\frac{1947\cdot 792}{3} \times 1000 = 649264$ number of bricks which are required. Or approximately

$$\frac{\left\{\begin{matrix} \therefore 14 \times 3\cdot 1416 \times \frac{18}{12} \times (120 \times 6) + \\ 17 \times 3\cdot 1416 \times \frac{18}{12} \times (120 \times 6) \end{matrix}\right\}}{2} =$$

52590·384 cubic feet of walling. And, as 1000 bricks = 3 cubic yards = 81 cubic feet, hence $\frac{52590\cdot 384}{81} \times 1000 = 649264$, number of bricks required.

JAMES BURROWS,
103, Chapel Street,
Dalton-in-Furness.

*Question* 3. (E.)—How are lifts arranged in a deep mine pumping engine?

*Answer.*—In very deep mines, subject to great water feeders, several lifts or sets have to be employed, the lower pumps raising the water out of the sump below the point of "hanging-on" up to cisterns from which the

; above obtain their supply of water. ly the bottom set or pump is a bucket ng one, and those above are forcing sets. s means each stroke of the engine does work; on the up-stroke the bucket lifts and the engine is approximately ed. The lifting set are worked by , and these are secured to the main by off-sets. The bottom of each set n a strong cross-beam of timber, and are placed at suitable intervals between the spears move, and the off-set spears ıg the plunger also work between guides. ımp sets are made secure in the shaft ntings and collarings, and these are below the flanges at every alternate Also, a number of horse-trees are put greater intervals; these are to give support, or, in case of any accident, re capable of sustaining the whole of ts above. The pumps are arranged k by quadrants, so that when the one ifting the other is plunging; thus the ts of spears and pumps are properly ed.

SAMUEL DAVIES,
Park Road View,
Worsbro' Bridge,
near Barnsley.

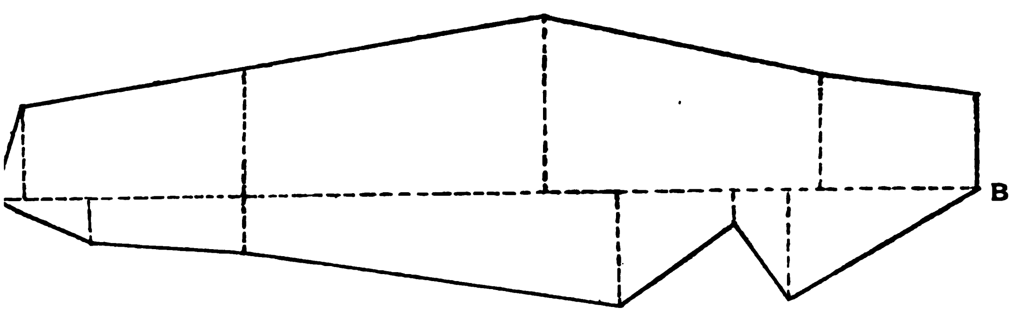
*Question* 4. (A.)—Plot the following irregular field which was surveyed by running a base line through it from end to end (A to B) with off-sets taken as shown in the adjoining column:—

| LINKS. | CHAINS. | LINKS. |
|---|---|---|
| | B | |
| 150 | 15·5 | 0 |
| 182 | 13·0 | |
| | 12·48 | 175 |
| | 11·59 | 55 |
| | 9·80 | 183 |
| 280 | 8·65 | |
| 202 | 3·93 | 92 |
| | 1·50 | 75 |
| 145 | 0·45 | |
| | A | |

*Answer.*—First draw the base line AB, pricking off on it the distances measured on the chain line. Next draw the off-set lines at right angles to the base line AB through the points on the base line AB; then prick off the measured off-sets on the off-set lines. and connect the several points.

J. H. SHERWEN,
Marina Terrace,
Hensingham,
nr. Whitehaven.

## — Plan of Field. —




*Scale : 3 chains to an inch.*

*tion* 5 (A.)—What construction of is best adapted to prevent breakage of screening?

*s question was answered in last issue, and ›en again by mistake. Messrs. Sylvesters, Limited, have however kindly forwarded illustration of their arrangements, so we take this opportunity of reproducing it for the benefit of our readers. For description see last issue.—Editor.)*

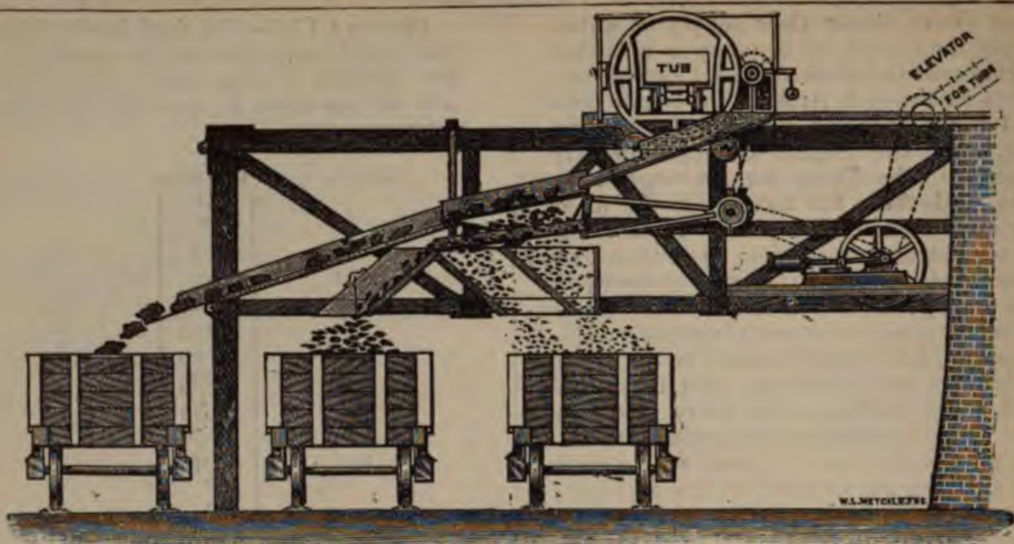



Illustration of Jigger, Screens, and Tippler.

*Question* 6. (A.)—What are the special advantages and disadvantages of steam pumping engines placed underground?

*Answer*.—The advantages and disadvantages of steam pumping engines placed underground may be summed up as follows:—

ADVANTAGES.—(1) Heavy rods are dispensed with, therefore less expense. (2) Less room required in the shaft. (3) Smaller engine required, as the engine would not have to lift the rods. (4) There is less liability to get out of order. (5) Easy to repair if any accident does occur. (6) Less cost in outlay.

DISADVANTAGES.—(1) There is a possibility of the engine being drowned out in case of a breakdown of the engine, should there not be much lodge room. The engines, however, are generally of the twin type—one resting while the other is working, and in case one breaks down, the other is set to work. (2) There is considerable damage to the roof and sides, &c., caused by the heat and steam. (3) Where the steam is carried from the surface, there is considerable loss of steam through condensation.

WILLIAM ATHERTON,
236, Woodhouse Lane,
Wigan.

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*Question* 7. (H.)—Give an account of installation for producing and distributing compressed air underground.

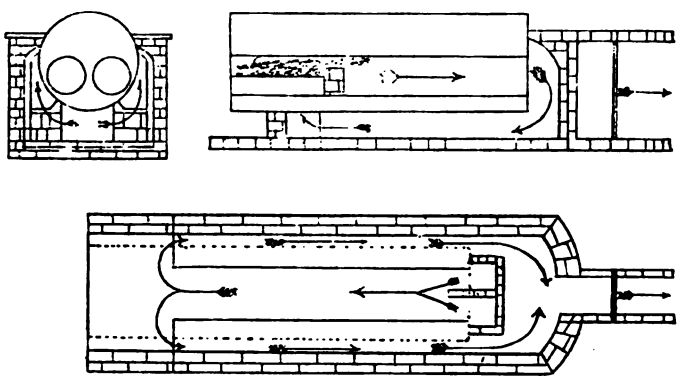
*Answer*.—The following is an account of an installation for producing and distributing compressed air underground:—The generator consists of two steam cylinders, each 20 inches in diameter, with a condenser attached, and also two air cylinders, 20 inches in diameter. The action of the intake and discharge valves are controlled by strong springs, cold water being kept flowing about each air cylinder to keep the compressed air as cool as possible. A fly-wheel is attached to the connecting shaft, with a boiler pressure of 50 pounds, the condensers working an air pressure of 70 pounds. The stroke is four feet, with 30 revolutions per minute, the total horse-power obtained being about 200. The air is discharged from the air cylinder into a large receiver, from which twelve-inch pipes are led to the pit bottom. Water given off by the air collects in the bottom of this receiver, being blown off periodically. Two six-inch branches are taken off the twelve-inch column, these being again split into two three-inch branches leading to the several motors. A large receiver is placed in each six-inch line of pipes, and a smaller one in each three-inch line near to the motors, the object of these being to collect water which is constantly being blown off, and at the same time to maintain a steady pressure of air to the motors, in which latter object the 12-inch pipes assist. Five pounds pressure is lost during transmission from the compressors to the motors. Pressures of 40 or 50 pounds per square inch are the most economical. With great pressure there is loss of power by radiation of heat from the pipes conveying the air. There is also more danger of ice being formed in the exhaust ports of the cylinders.

GEO. ROBINSON,
Dallas Villas, Langwith, Mansfield.

*Question* 8. (H.)—Show, by sketch, how steam boilers are built in, and heated gases conducted from the fire-grate to the chimney.

*Answer.*—In order to increase the heating surface of egg-ended boilers they were latterly constructed with a flue passing from end to end. The products of combustion from fire-grate underneath the boiler, after moving to the back end, returned through the flue to the front end, and then passed back to the chimney along the lateral flues. When, however, it was discovered that the radiation of heat from a boiler furnace amounted to 20 or 30 per cent. of the total heat of combustion, the furnaces were placed inside this flue so as to impart to the water surrounding the flue more of the heat radiated from the furnace.

Cross Section. Longitudinal Section.



Ground Plan.

The accompanying diagrams consisting of a longitudinal section, a cross section, and a plan shew the flues and how heated gases are conducted to the chimney. The products of combustion pass from the fire-gate through the flues to the back end of the boiler, in the direction of the arrows, where they drop down to the lower flue and travel away underneath the boiler to the front end, where they again rise and pass along the side flues, and then pass away up the chimney. In the Cornish boiler the heated gases pass along the tube, and then divide and pass along the side flues, were they drop to the bottom and then pass away to the chimney. By this arrangement the gases are reduced in temperature before coming in contact with the bottom of the boiler where all sediment collects, and there is no danger of burning the plates on the under side of the boiler. Sometimes, when the gases are discharged from the furnace-flue into the lower flue (unless in the case of very long boilers where the gases may be considerably cooled down before leaving the furnace flue, or where the water is very pure), this plan is objectionable, as the plates underneath are liable to be burned owing to the sediment accumulating. At the back of the furnace is the bridge built of bricks (fire-bricks) which throws the heat and gases, &c., up against the boiler. The boiler is supported upon the fire-brick blocks which run the whole length of the boiler and form part of the side and bottom flues. The flues are all lined with fire-bricks on the inside, and common bricks on the outside. When the boilers are first put in they are generally chocked up on wood blocks, and left in until the fire is put in, and then generally burnt out, the boiler blocks being built up first, when of course the boiler rests firmly upon them.

WILLIAM B. FORSTER, Tudhoe Colliery, Spennymoor.

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*Question* 9. (M.)—Give a description of the coal and roof of a seam you are well acquainted with, and describe fully the method of working it, and the advantage of the method adopted as compared with any alternative method. Make a sketch of same, giving distance between roads. Also under the various heads of a cost sheet the approximate cost per ton of coal raised.

(*No suitable Answer received.—Ed.*)

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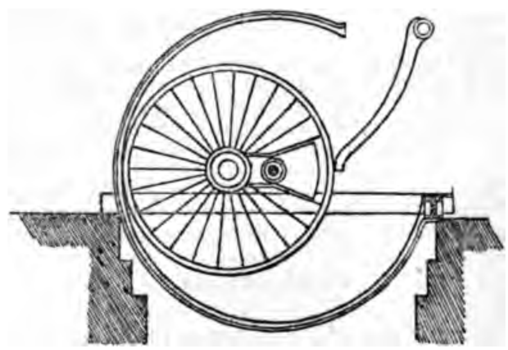
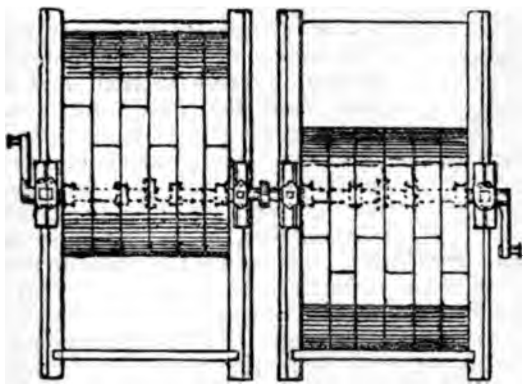
*Question* 10. (M.)—Describe, with suitable sketches, *Cooke's* Ventilating Machine.

*Answer.*—*Cooke's* Ventilator will be easily understood from the sketches. It consists of a pair of drums fixed eccentrically on the same



shaft, and revolving in separate chambers which are as near a fit to the sides and circumference of the drums as possible without actually touching. An opening on one side

of each chamber admits air from the mine; another at the top of each chamber allows the air to pass into the atmosphere. Each chamber is provided with a swinging valve or shutter worked by levers outside the chambers, so that it is always nearly touching the drum. The mine air cannot pass this valve, hence it is forced into the atmosphere out of the upper opening. As each revolving drum passes its lower opening it drives the air before it and out of its upper opening, at the same time drawing from the mine another chamber full of air. The drums are about 22 feet in diameter and 11½ feet wide, and are



fixed opposite each other on the shaft, so that a balance is effected, and a regular current of air is extracted from the mine. The useful effect of these machines is from 25 per cent. to 60 per cent. according to the construction of machine, and the condition of the mine at which it is placed.

SAMUEL THORPE,
Chevet View,
Ryhill, Wakefield.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### SURVEYING.

Sir,

Will any of your readers kindly answer the following questions:—(1) What is meant *by* parallax and collimation? Does any allowance have to be made for them, or cannot the level or dial be properly used when they occur? (2) Can logarithms be worked out without reference to tables; if so, how? and when the log of a number is found, how is the natural number obtained again? Yours, etc., B.C.

### MECHANICS.

Sir.—I will be very much obliged to have the following questions published through your valuable paper, and I trust some of the interested readers will answer them.

(1) A train weighs 80 tons, and its speed is 40 miles per hour on a level rail. Find h.p. of engine, if the gradient was 1 in 100 and the engine exerted the same power, find speed of train.

(2) An engine of 100 h.p. ascends a gradient of 1½ in 100 at a speed of 20 miles per hour. Find weight of train in tons.

(3) A body weighing 8 cwts. is drawn along 100 feet of an incline which rises 2 feet in height for every 5 feet along the plane, the resistance of friction being neglected. Find work done.

(4) A car laden with 20 passengers is drawn up an inclined plane one end of which is 160 feet above the other. The car when empty weighs two tons, and the average weight of each passenger is 140 pounds. Find the number of foot pounds of work done in ascending the incline, friction being neglected. R. Cockburn.

### Suggested Enlargement of "Mining."

Sir.—I am only one of the many readers of "Mining," but I should like to suggest a few things for the consideration of yourself and my fellow-readers of "Mining." There is no doubt that "Mining" is the best journal for miners; I consider it *the* best going. I have paid three times the money for mining papers not half so much adapted for the working miner as is "Mining." In No. 7, Vol. II., is a letter from Editor complaining of being short of space, and so you must be, for I have sent other letters that have never appeared in print. Now, suppose the price of the journal was raised to twopence instead of one penny, would not this afford a few more leaves in our journal? and every reader pledge himself to get another, and use extra space for correspondence on mining matter, and a pen and ink debating page. Awaiting consideration. Yours, Horace Rowley.

(We should like the opinion of others of our readers regarding this letter, though we do not think it advisable to increase the price.—Ed.)

*Printed and Published by* Strowger and Son, Clarence Yard, Wallgate, Wigan.


o 10. Vol. II. SATURDAY, APRIL 7, 1894. FORTNIGHTLY ONE PENNY.

## CONTENTS



# MINING LECTURES

By C. LATHAM,

Lecturer to the County Council and University of Notts.

*(Specially written for this Journal.)*

Commenced in No. 8, Vol. II.

No. 1 CONTINUED.

## COAL: ITS HISTORY, COMPOSITION & USE.

THE fact that all running water carries along in suspension large quantities of fine sand and mud, is one which I think is well known to all. Should we care however to prove it for ourselves, we can readily do so, all we require is to carefully fill a glass vessel with water taken from a brook or river; we shall find that after the water has been standing for some little time the bottom of the vessel becomes covered with fine material, this fine material being nothing more or less than the sand or mud which has been carried in suspension in the water, and on the latter becoming stationary it has been deposited, owing to its weight, in one even layer over the bottom of the vessel.

What do we learn from this in proof of our theory, why if we for a moment suppose the first theory correct, then how comes it that we find beds of coal several feet in thickness consisting of pure vegetable matter, is it possible that the brooks and rivers of those days brought down nothing but pure vegetable matter unmixed with anything else? No.

Is it not more likely that any coal formed by this theory would consist of vegetable matter, sand, and mud, which have by the various actions of nature become coal, sandstone, and shale. Should we not have two or three inches of coal, two or three inches of sandstone, two or three inches of shale, and I fancy in many cases not even this division into layers, but one confused mass of coal, sandstone, and shale, due to the water when it came to rest in the lake or sea depositing vegetable matter, sand, and mud in a mixed condition just as it had brought them down from the higher ground.

Again we may readily find that most seams of coal have one uniform thickness over very large areas. For instance if we take a four-foot seam at one place and trace it for ten, twenty, or even more miles we find it has not either increased or decreased in thickness, but still stands within a few inches of its original dimensions.

How can we apply the first theory to this formation. Can we for a moment imagine that brooks and rivers when laying out their vegetable matter at the bottom of some lake or sea would do so in one even layer, should we not have a heap here and a heap there, the space between being filled with other material, and not one continuous bed of the same thickness of pure vegetable matter.

Now in the first part of our lecture we have mentioned the fact that coal consists largely of the seeds of ferns, plants, &c. If we for a moment carefully examine these seeds we find that they are waterproof, and when thrown into water they do not sink but swim on the top. How then have they become embedded in the coal, for when the river discharged its contents they would not become waterlogged and sink like the vegetable matter, but would rise to the top and remain there as long as the lake or sea contained any water to support them.

Let us now turn to the material forming the floor of the coal seam, and we shall find that no matter how hard it may be in one case and how soft in another it consists of just the same elements, the only difference being due to changes brought about by changed conditions. On examination we find these elements to be the same that today form our surface soils. This bed then has once been soil. Moreover how is it we find every true coal seam to rest on such a bed, if each seam has been formed by the deposit theory; is it possible that the bed of every lake or sea would be composed of just the same material; is it possible that the brook or river would always gather up this material and deposit it before laying down any vegetable matter on the top? No, a thousand times, no!

If we carefully examine this bed, or as we more commonly term it "warrant," on which the coal rests, we shall in many cases find long stringy pieces of black coaly or carbonaceous matter running through it, and on closer inspection we may be rewarded for our trouble by the discovery of a fossil tree standing erect in the coal seam, and in some few cases extending into the roof above. Such a discovery as this was made many years ago in a railway cutting near Bolton in Lancashire, and this fact has in no small measure been the means of enabling us to account in a satisfactory and rational manner for the coal formation.

It was found that the stringy carbonaceous matter which we have mentioned in the warrant, was firmly attached to the bottom of this tree, and then the question then brought forward was one of relationship. Was it not highly possible that they were tree and root. The warrant had formed the soil on which the tree grew, its roots had extended right and left in this soil, and owing to them being composed of vegetable matter, they like the body of the tree had become converted into coal.

From this then we take our stand and lay down the second theory as the only one which will stand the light of investigation, and we shall now try and describe as clearly as we are able how coal was formed. We have had a low lying tract of land, perhaps many hundred miles in extent, this land has been thickly covered with a most luxuriant vegetation, a vegetation which rapidly grew, rapidly died, and still more rapidly decayed away, we have had a forest springing up, flourishing, and dying away, its seeds have fallen around, and the result has been another forest has sprung up and taken its place, this in its turn has flourished and died and been succeeded by another and so on, perhaps for thousands of years, until the vegetable matter has attained a thickness of say 10, 20, 30, 40 or even 50 feet.

Have we anything at the present day to illustrate this action? Yes, peat bogs give us about as good an idea as we could wish for of what took place at that remote period of the earth's history.

*(To be continued.)*

## HAULAGE.

### Chapter IX.

*Continued from Number 8.*

### Tail-Rope System.—(Contd.)

SUNDRY APPLIANCES.

FIGURE 1 shows an automatic arrangement for detaching the tubs in the main-and-tail-rope system on their arrival at the shaft. It consists principally of a bent lever, which works on a pivot fixed on the front end of the first tub. One arm of the lever is vertical, and the other horizontal. To the horizontal arm is connected a small chain, the other end of which is attached to the link which fastens the rope to the tub. A bar is fixed near the shaft at such a height that it will strike the vertical arm of the lever, and, by this means, disconnect the chain.

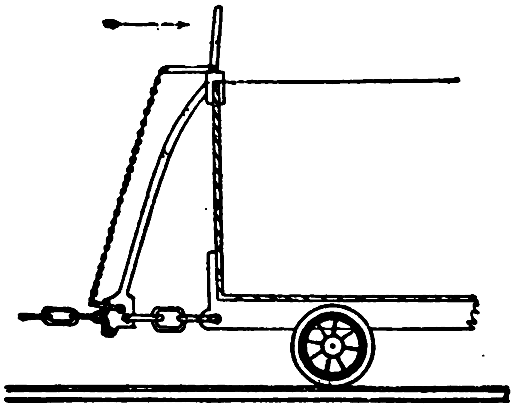


Fig. 1.—Automatic Detacher.

Fig. 2 illustrates the devil or run-away catch, used in this system of haulage to prevent the tubs from running away, especially if the gradient is great. It scarcely needs describing, as its mode of action will be easily understood. So long as the rope remains tight the devil will be lifted out of the way, but should the rope break, the couplings would become slack and allow the devil to drop, and thus stop the tubs.

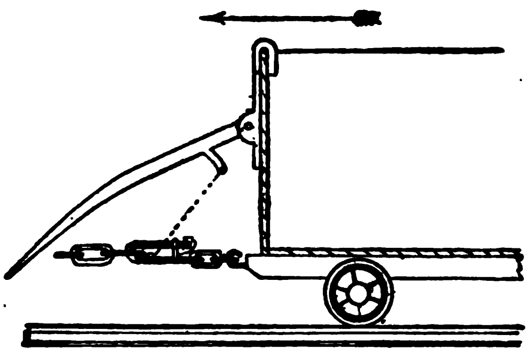


Fig. 2.—Devil for Stopping Run-away Tubs.

Fig. 3 shows an arrangement of the road at a curve; the space on the left of the rails is intended for a travelling road, and inside the ordinary rails two other check rails are placed to prevent the tubs from running off. The lower pulley or sheave is for the main-rope, and the top one for the tail-rope. The frame of the tail-rope pulley may be provided with a bracket to keep the rope in position, but this is of course impossible with the main-rope pulley.

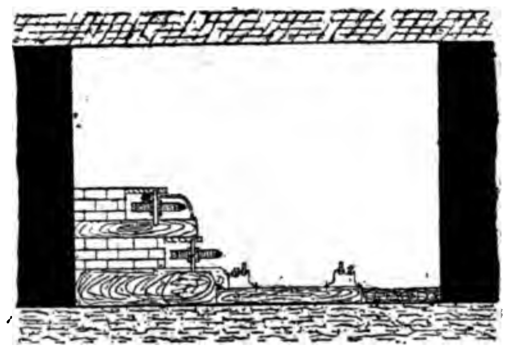


Fig. 3.—Section of Roadway at Curve.

Figs. 4 and 5 shew the elevation and plan of self-acting doors for the main-and-tail-rope haulage. The door is made of two parts, and instead of being provided with hinges they work on pulleys, which run on inclined rails situated above the door. The pulleys are connected to the door by straps of iron, so that to open the door the two divisions must be spread

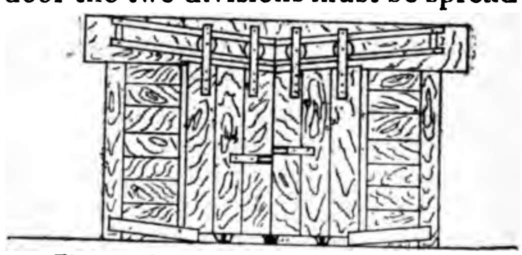


Fig. 4.—Automatic Door (Elevation).

open laterally. The main-rope runs through a hole left for it between the doors at the bottom, and the tail-rope passes through a hole in the wall at the side of the door. The doors are opened by means of two long bars of timber (10ft. long) faced with iron, being fitted to each side of the door, as shown in plan, Fig. 5. The end of each bar is fastened to the door by means of a hinge fixed at the junction of the doors, and about 21 inches above the height of the rail. The other end of the bar is secured to a

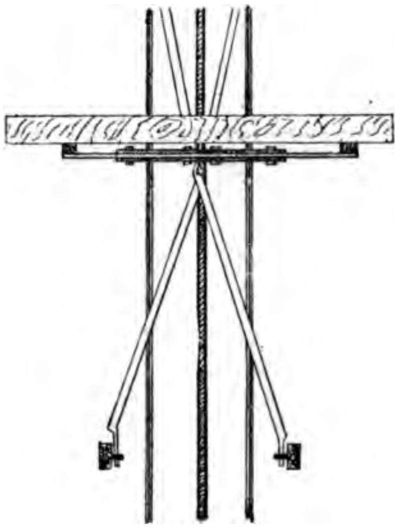


Fig. 5.—Automatic Door (Plan).

post by an eye-bolt so as to allow the end to move backward and forward a little. The road posts are fixed so that the tubs will have just sufficient room to pass. When a train of tubs is required to pass through the door, the rope pulls the first tub along until its front comes in contact with the bars, causing them to spread out away from each other, and thus open the doors. When the train has passed through, the doors spring together. The slides upon which the pulleys work are inclined inward in order to give the doors the necessary force to shut together. It will be necessary to have two doors of the manner described placed at a sufficient distance apart to allow the train to have effectually passed one before the other is opened. Sometimes the necessary power for pumping at the in-bye end is taken from the return sheave in this method of haulage, or it may be taken from the tail-rope at an intermediate position on the plane.

Fig. 6 shows an arrangement of the rails at an intermediate station, say *the bottom* of a self-acting incline.

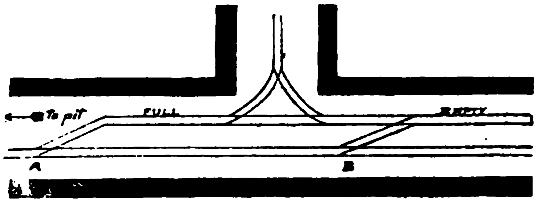



Fig. 6.—Arrangement of Rails at Sidings.

When the empty set is going in-bye it is stopped between A and B. The ropes are then changed to the full train, which is in the road opposite AB, and the full gang is drawn towards the shaft. The points at B are turned, and a gentle fall in the road allows the empty tubs to run into the empty siding.

N.B.—This article concludes the description of the main-and-tail rope method of haulage. The methods yet remaining to be described are the endless chain and rope systems. We will withhold these articles however, until a portion of the very important matters which have been allowed to accumulate, owing to the lack of space, have been published.—Ed.

## THE SCIENCE AND ART EXAMINATIONS.

*Continued from last issue.*

The Annual Examination of the Science and Art Department in the Principles of Mining will take place on May the 8th, and students may be examined at any of the department's centres. The subject of mining is divisible into two branches of coal and metalliferous mining, and why this department does not hold separate examinations on the two branches is impossible for us to say, and has been the subject of comment for many years. Of late years separate exams. have been held on the two branches of theoretical mechanics, namely solids and liquids; and again, sound light and heat in the advanced stages have been divided. Yet the examination in Mining runs on its old sweet course, either oblivious to the advancement of its fellow subjects, or smiling sarcastically at their weakness in attempting to keep pace with time.

The department's directory, however, informs us that the examination papers will be so constructed as to suit candidates who have studied, or have been practically engaged in, either branch. We will show our readers how far this statement is correct. The papers contain questions on both branches, and about two-thirds of the questions have to be answered *only*. We grant that this affords an opportunity for students engaged in either branch to obtain a certificate, but the surplus questions are not added to Mining because the two branches of the subject are combined, but because it is the general rule of the department, and is adopted in all the other examinations, The result of this is that a mining student must obtain a larger percentage of marks, comparatively speaking, to obtain a certificate than any other.

In order to enable the advanced student to understand the style of questions which are usually asked, we append the questions given last year.

### ADVANCED.

*Your are only permitted to answer Seven questions. Time allowed is Three hours.*

(1) How is the ore-bearing quality of lodes found to be affected by changes in the containing rock or country? Give some examples.

(2) How may the minerals in a tin, copper, or lead lode be expected to change in depth when the level of free drainage is passed?

(3) In some coalfields the measures are penetrated by dykes of igneous rocks. What is the effect of such intrusions upon coal seams where they are in contact?

(4) How would you prove a coalfield by boring for the purpose of fixing the position of a new sinking?

(5) Give a sketch of the method of sinking and walling in ordinary coal shale and sandstone measures when intermediate bearing curbs can be used. What weight of material would be excavated per 100 yards in a pit 16 feet in diameter?

(6) Describe some methods of using iron or steel, instead of timber, in shafts or levels?

(7) Describe a system of working a 4-feet seam of coal of 35 to 50 degrees dip, either by dip or rise working, shewing the methods of securing the faces and of removing the coal to the main road, and the course of ventilation.

(8) Describe two different kinds of mechanical ventilators, giving their relative efficiency.

(9) Describe, in detail, some form of underground pumping engine.

(10) Describe, with figures, the construction of a cage and guides suited for a large colliery.

(11) What plans and sections are necessary to represent the workings on a mineral vein?

(12) What is the order of operations following in cleaning tin-stuff containing pyrites and arsenic?

In our next issue we will publish the Elementary Questions.—(*Editor of Mining.*)

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

(*Continued from No. 9, Vol. II.*)

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

### Subject.— SURVEYING AND GEOLOGY.

Question 1.—Give a description of the ordinary miners' dial, and of a theodolite.

Answer.—The Miners' dial is an instrument used chiefly in surveying the underground workings of a mine. It is so arranged that the survey can be made either with loose or fast needle. It consists of a compass, a box from five to six inches in diameter, a graduated circle (fitted inside the box) divided into 360 degrees, and marked at every 90 degrees N., S., E., W. A magnetic needle fitted on a very fine point, and an agate cap fitted on it. North end of needle is usually distinguished by a short pin placed through it, or a mark across. Over this a glass case or cover is placed to protect it from moisture, etc. Also, inside there is placed a vernier, which enables us to read parts of degrees, etc., in angling. There are also two arms, with sights, in centre of instrument, two spirit levels at right angles to each other, to enable the instrument to be levelled before taking a sight. There are other fittings attached,

such as a clamp for fastening needle when not in use, a pin to detach the upper and lower plates when angling, and a slow-motion screw for carefully adjusting the sight to the object required.

The theodolite is an instrument used for measuring angles, taking heights, etc. It consists of a telescope with a spirit level fixed on it, which rests on upright supports. By means of a vernier the angles of elevation or depression are read, and in order to see them better a microscope is fitted on the instrument which can easily be moved to any portion round the circumference of circle. The instrument stands on three legs, and has a brass ball and socket with horizontal plates, spirit levels to adjust it.

QUESTION 2.—Give a description of the dumpy level, and show how you would record staff readings and variations of levels in a book.

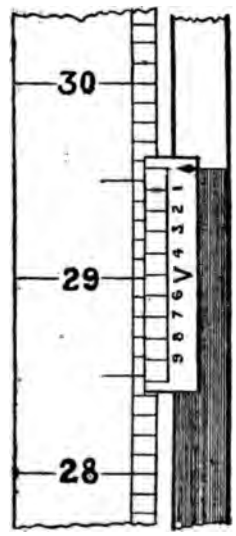
ANSWER.—Dumpy level consists of a telescope fixed on a horizontal bar, and attached to the telescope is a focussing arrangement, and a cross level fixed at right angles to the principal level, or sometimes a circular level is placed immediately under the telescope, thus enabling the instrument to be fixed accurately level the more readily. Beneath this bar is a conical axis passing through the upper two parallel plates and terminating in a ball supported in a socket, by which you can adjust the telescope in any direction. The parallel plates are connected by four milled-headed screws which turn in sockets fixed to the lower plate whilst their heads press against the under side of the top plate, and so manipulate the instrument to its proper level. Near the eye-piece of the telescope is a diaphram carrying cross hairs, by means of which the person levelling reads the staff. I should record the reading in a book, every page of which is divided into six parts, and headed as follows :—

| Distance in Links. | Sights. Back. | Sights. Fore. | Height of Instrument. | Reduced Level. | Remarks. |
|---|---|---|---|---|---|
| | 9·5 | | 109.5 | 100·00 | |
| 100 | | 6·25 | | 103·25 | |
| 140 | | 9·3 | | 100·20 | |
| 200 | | 9·5 | | 102·00 | |
| 250 | | 8·5 | | 101·co | |

For example, if you started at 100 feet above datum line you take reading of back sight, which we will say is 9·5. Then place this reading as above. It is obvious that the height of instrument is 100 + 9·5 = 109·5 *above datum line.* Place this in its own column. Every other reading in that setting is called foresight, and must be booked as such. Next reading is 6·25. This must be booked in its column, and this level reduced is 103·25 (see above), and so on to the required distance, then the difference of sight gives the rise or fall as it may be.

QUESTION 3.—Make an ink sketch of a vernier, and explain its use and value when fitted to instruments.

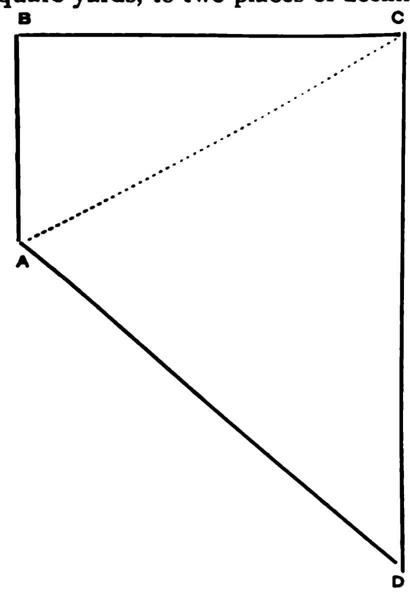
ANSWER.—The use of a vernier is to enable measurements to be taken accurately by ordinary observations.




It is also adapted to the more accurate reading of angles. The vernier consists of a small graduated scale or arc, and it is made to slide along a larger scale or arc. The construction and use of the vernier will be best understood by reference to the sketch, which is intended to illustrate the use of the vernier for reading the barometer, and, in like manner, all other measurements. The small sliding scale (V) represents the vernier, and it will be noticed that ten divisions on the vernier equal eleven divisions of the fixed scale. The fixed scale is an ordinary inch one as appplied to the barometer, and as there are ten divisions to an inch, each division equals $\frac{1}{10}$th of an inch. But the ten divisions of the vernier equal $\frac{11}{10}$ths of an inch, therefore, one division equals $\frac{11}{100}$ or $\frac{1}{10} + \frac{1}{100}$ of an inch; that is, each of the divisions on the vernier is $\frac{1}{100}$th of an inch greater than those on the scale. Now, to measure the height of the barometer, slide the vernier along until the zero mark is exactly on a level with the mercury in the tube. It will then be apparent that the height of the barometer is 29·5 + a fraction, and what we require is to ascertain this fraction. To do this we must find which line of division on the vernier exactly coincides with some division on the scale. In this case it is the seventh. Then the height to be measured is 29·57 inches.

QUESTION 4.—The sides (AB, BC, CD, DA) of a field measure 28, 45, 60, and 57

·ds in length respectively. The angle ABC ι right angle. Find the area of the field square yards, to two places of decimals.




Answer.—First find the diagonal AC. ien we have the figure divided into two angles, each of sides given.

Diagonal = $\sqrt{45^2 + 28^2} = 53 = AC$.
nd area of triangle ABC.

$$\frac{45 + 28 + 53}{2} = 63.$$

$$63 - 45 = 18.$$
$$63 - 28 = 35.$$
$$63 - 53 = 10.$$

$(63 \times 18 \times 35 \times 10) = 620{\cdot}21$ area of ABC.
·iangle ACD.

$$\frac{53 + 60 + 57}{2} = 85.$$

$$85 - 53 = 32.$$
$$85 - 57 = 28.$$
$$85 - 60 = 25.$$

$(85 \times 32 \times 28 \times 15) = 1069{\cdot}33$ area of ACD.
$1069{\cdot}33 + 620{\cdot}21 = \underline{1689{\cdot}54}$.—*Answer.*

Question 5.—Explain fully how you would ·ep up a colliery plan, and run it as a check ·on the quantity of coal raised.

Answer.—In the first place I would survey e workings of the mine every three months ıd mark accurately on the plan the position the workings after each survey. By doing ı it would enable me to calculate the area coal wrought every three months, and, as ·ery colliery keeps an account of coal raised would enable me to compare the results, nd check the amount of coal got.

*(To be continued.)*

## COMPETITION QUESTIONS.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

1st—All envelopes must be marked "Competition."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3rd—Correct name and postal address must be sent.

4th—They must reach us by April 14th, 1894.

### ELEMENTARY.

*Question* 1.—What are safety lamps, and state what limits are they to be considered safe?

*Question* 2.—A pit 14 feet long, $5\frac{1}{2}$ feet wide, and 80 fathoms deep. Find weight of debris raised, if 130 pounds equals one cubic foot.

*Question* 3.—What are the regulations as to the opening of safety lamps in fiery mines?

### ADVANCED.

*Question* 4.—How is the sinking of a shaft conducted when the upper part is in use for drawing materials?

*Question* 5.—Describe the contrivances necessary for splitting and coursing air currents underground. Give sketches of same.

*Question* 6.—What interruptions are likely to be met with in working coal seams?

### FIRST-CLASS.

*Question* 7.—Describe the construction of a pumping engine driven by the pressure of a column of water.

*Question* 8.—Describe the general arrangement (with sketch) for working a syphon.

*Question* 9.—If a mine 5 feet high (having two brows 500 yards each in length, cut through every 30 yards, the pillar between brows being 30 yards wide) were filled with an explosive mixture, show by sketch, and explain fully what method you would adopt to clear them.

*Question* 10.—Show, by a sketch, how you would direct the air current in six places (working widework) when two of them are fallen up at the face. Mark the cross roads and drawing roads.

## ANSWERS TO QUESTIONS
**In No. 8, Vol. 2.**

### ELEMENTARY.

*Question* 1.—Describe the method of measuring air with anemometer and with powder smoke. Which is the best? How many cubic feet of air are there in a current having a velocity of 127 feet per minute in a drift 6 feet 2 inches high by 7 feet 6 inches wide?

*Answer.*—In measuring air with an anemometer I would first find some part of the roadway where the section was nearly uniform, place my lamp where I could see clearly, then enter the reading of the anemometer in my book. Holding my watch in my left hand and the anemometer in my right, I would note when the seconds pointer of the watch was at 60, then release the catch of the anemometer and hold it in the air for a full minute, gently moving it about from side to side and from top to bottom of the roadway; Then stop the instrument. I would subtract the reading in my book from the reading indicated, and the quotient will be the velocity in feet per minute. This multiplied by the area of the airway will give the quantity in feet per minute.

To measure the velocities of air-currents with powder smoke it requires two men placed at a certain distance in one of the main in-takes of the mine. One man lights the powder while the other man watches the flash, noting the time by a watch which the smoke requires to travel the required distance. Say it requires ten seconds to travel forty yards, then the velocity in feet per minute is $\frac{40 \times 3 \times 60}{10} = 720$ feet per minute. The number of cubic feet of air in the above-named current is 6 feet 2 inches $= 6\frac{1}{6}$ feet height; 7 feet 6 inches wide $= 7\frac{1}{2}$ feet wide. Now, $6\frac{1}{6} \times 7\frac{1}{2} = 46\frac{1}{4}$ feet area of airway. $46\frac{1}{4} \times 127$ feet velocity of air in feet per minute $= 5873\frac{3}{4}$ cubic feet of air per minute.

HIRAM BRADLEY,
Whitehall Road, Drighlington,
near Bradford, Yorks.

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*Question* 2.—Describe some of the various methods of preserving timber for underground use, comparing their relative efficiency.

*Answer.*—Many schemes have been tried to protect timber from the injurious effects of the cotton-mould fungus. Water has been caused to trickle down the timber, but this is an expensive and impracticable proceeding. Steeping the timber in salt brine has been tried, with moderate results; the sulphates of copper, zinc, and iron have each been tried, with moderate results; charring the surface of the wood with fire has been tried, and failed; coating the surface of the timber with coal-tar and white-washing the skin of the timber with quick-lime have been tried, but these only produce moderate results, because when the timber is steeped in salt-brine or the sulphates, or white-washed with quick-lime, or coated with coal-tar, the skin only is affected, and all applications to the timber have proved total failures, as the timber cracks when it becomes dry, and the germs of the fungus at once enter, and destruction begins.

*Hyan's* Method.—Here the timber is immersed in a solution of chloride of mercury containing 150 parts of water.

*Pain's* Method.—In this case the timber is steeped in a solution of sulphate of iron and sulphate of barum, but this, instead of hindering, assists the work of decomposition, and destroys the fibres of the wood.

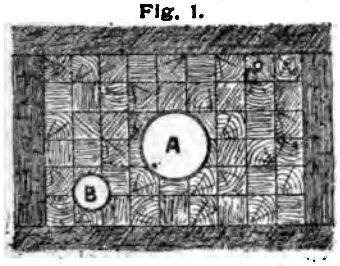
Up to the present time, no preparation of the timber has effected real good except the application of creosote. Kresote or creosote is an oily colourless liquid made from the distillation of tar. The action of the cotton-mould fungus begins first to set up fermentation in the wood, and then destroys it. This is destroyed by creosote, which stops its fermentative action. In creosoting, the timber is dried, and placed in a wrought-iron cylinder which is made air-tight, the air being then pumped from the cylinder and pores of the timber by means of an air pump. Beneath the creosoting tank is a store tank filled with creosote rich in napthaline and free from ammonia. The creosote is now pumped from this store tank into the creosoting cylinder by a donkey engine, and this is continued until the pressure equals 100 lbs. on the square inch. Creosote enters the wood readily when the creosote is at a temperature of 120 degrees F. Timber such as fir, pine, &c., absorbs from 10 to 12 pounds of creosote per cubic foot, while oak and other hard woods do not absorb more than 6 pounds per cubic foot. For this reason soft woods will withstand decay better than hard woods in the proportion of the creosote absorbed.

THOMAS SISSON,
Stanley Common, Derby.

*Question* 3.—Describe, with sketch, the construction of a dam to keep back water.

*Answer.*—Sketch (Figs. 1 and 2), shows a good form of dam for such a purpose. It can be constructed to withstand any pressure or head of water. In selecting a place for these dams the ground should be as solid and free from cracks and breaks as possible, and the roof, floor and sides should be sheared wedge-shape, and should be lined with tarred flannel before commencing to build the dam. The dam illustrated is termed a frame dam, and is usually made of fir baulks, 9 inches square at the thick end, and tapered to 6 inches square at the thin end. It is generally 5 or 6 feet

Fig. 1.



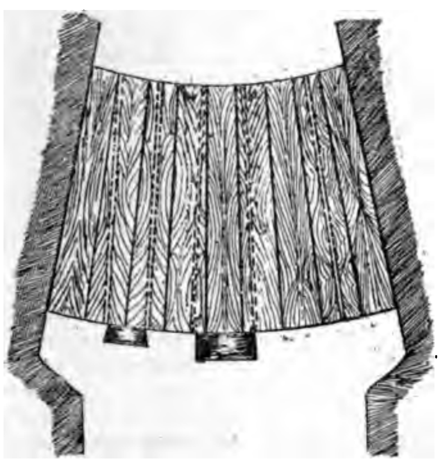



Fig. 2

long, and placed as shewn in sketch. C is a small pipe to allow all gas to escape until the water has risen and covered the whole area of the dam; it is then plugged. A is a round hole, 18 inches in diameter, for allowing the persons engaged in putting in the dam to pass out after it is completed. B is a pipe for water to run through while the dam is being built. The back of the dam is firmly wedged with wooden wedges. When the wedging is completed a plug is driven in the pipe (B); the workmen then pass out through the hole (A), drawing at the same time a large plug into the hole as they pass out. This plug is made to taper, so that the greater the pressure of water at the back of the dam, the tighter the plug.

GEORGE DEVERILL,
6, Bride Place,
Hempshill Lane, Bulwell, Notts.

## ADVANCED.

*Question* 4.—Describe, with sketch, the *Barnsley* method of working thick seams of coal.

*Answer.*—The method of working the thick seams of Barnsley is by what is termed the "double-stall," as seen in the accompanying sketch. This is done by driving levels from the pit bottom in the usual way, and then the whole mine is divided into districts, and these districts are divided into stalls, the stalls being driven 14 yards wide. First they drive two narrow places two yards wide, and when they are about six yards in, each place widens out five yards towards the other, and the 14 yards is then taken in abreast till they are within a few yards off the other sets of stalls, and then it is stopped. If the barrier has to come out, each one brings five yards back with them till within six yards off the levels. This leaves a narrow pillar of coal between the levels and the goaf. The tramway is laid between the coal wall and the pack wall, all the rubbish being laid between the pack walls. This seam is sometimes worked by the long-wall method. GEORGE DAYKIN,
24, High Guerney Villa,
nr. Bishop Auckland.

*Sketch for above appeared in No. 19, Vol. I.*

*Question* 5.—If a pumping engine, with a 17-inch set, 5-feet stroke, going 3 strokes per minute, and working 11 hours a day, can clear a mine of water in 4 days, in how many days will an engine working a 13-inch set, 4-feet stroke, going 7 strokes per minute, and working 19 hours a day, do the same work?

*Answer.*—

$$\frac{17^2 \times 5 \times 3 \times 60 \times 11 \times \cdot034 \times 4}{13^2 \times 4 \times 7 \times 60 \times 19 \times \cdot034} =$$

$$\frac{17^2 \times 5 \times 3 \times 11}{13 \times 7 \times 19} = 2\cdot1215 \text{ days}, =$$

2 days, 2 hours, 18·5 minutes.

PETER CLELLAND,
Shirva, by Kirkintillock,
Dumbartonshire, Scotland.

*Question* 6.—State the various methods of raising water from mines. Describe the safest and most approved kind of pumping engine for that purpose.

*Answer.*—The following are the various methods of raising water from mines:—(1) Adit levels. (2) Winding water with cages. (3) Pumping water, viz.:—Lifting set and forcing set. The lifting set consists of windbore, clack piece, clacks or valves, working barrel, pumps or stocks, and rods or spears. The forcing set consists of dry spears, iron plunger or ram, working barrel or plunger case, stuffing box at the top clacks, windbore and pumps. The above engine is placed at the surface. (4) Underground forcing pumps. In this, the engine is placed as near the shaft bottom as possible, and it forces the water to the surface, the engine being driven by either steam, compressed air, or electricity. The one that has just been described in No. 6, Vol. II, of this valuable paper, is the latest that I have read about, known as the "aqua thruster." The steam acts directly on the surface of the water, dispensing with all working parts that need oiling and packing, and therefore it is seen that it is less likely to get out of order. After the steam has done its work in the pump it goes into a slow state of condensation. The height to which it will raise water is about 100 feet, or two or more may be coupled together to raise the water to a greater height. The pump mostly used in latter days is the underground forcing steam pump.

GEORGE DAYKIN,
24, High Gurney Villa,
near Bishop Auckland.

## FIRST-CLASS.

*Question* 7.—Describe and illustrate by any sketches you may deem necessary, how you would support an excavation preparatory to building a rather large arch, and state how you would proceed with the brick-work. Describe also the manner in which the excavation is cut or driven.

*Answer.*—The accompanying sketch shows the method of supporting a rather large excavation, and the mode of procedure in building the arch. Taking the excavation to be a large tunnel in a mine, they are driven in the following manner:—A road is driven in the fast at the bottom, 4 or 5 feet high, and sufficiently wide, to the required distance. The rails, etc., taken out and operations commenced again at the end where they commenced at first—similar, in fact to the over-hand method of stoping in metal mining. The props supporting the roof are then taken out and sometimes the top part will fall of itself to the required height, and, if not, it will take only a very small amount of explosives to break it down, the roof above being supported by bars with the ends let into the sides, and covering wood at the top of these. If there is a great side weight to be supported they are secured by long planks fixed vertically, and a long plank fixed longitudinally, bars being wedged against the longitudinal planks both top and bottom, the wedging bars being fixed far enough apart so as to allow of the arch being built between. The distance of one length of arching is from four to six yards long. I would proceed with the brickwork as follows:—Put the side walls in to the height where the spring of the arch commences; then fix the pillars on which to support the centres, and secure the centres with two lags bolted to the top. Commence by placing two or three lags on to the centres and then building this up, and so on all the way round, until the arch was completed. Suitable scaffolds would have to be built as would be most convenient. The centres are left up until required again for another length of brickwork, thereby giving the brickwork time to set. The top of the arch is filled with debris in order to distribute the pressure.

THOS. BANKS,
Church Road, Haydock, Lancs.

*Block not to hand. Will appear next issue—Ed.*

*Question* 8.—What precautions should be adopted where candles and safety lamps are used in different parts of the same mine?

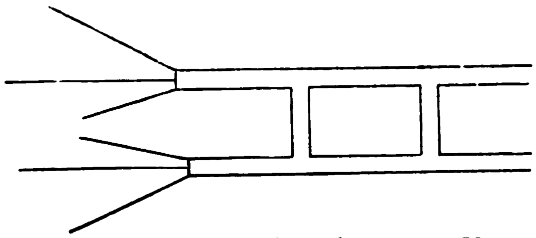
*Answer.*—In a mine where naked lights are used, and it becomes necessary to use locked safety lamps in certain districts, great care should be taken not to allow naked lights to be used in that ventilated current, beyond where safety lamps are in use. A notice board should be fixed at the beginning of the district where lamps are in use, specifying that naked lights can be carried no further.

GEORGE HUGILL,
Middle Ridge Farm,
Burnley.

*Question* 9.—The workings in a four-feet seam of coal approach an extensive waste, containing water, with a head of 40 fathoms which has to be drained. Show, by sketch, and describe how you would tap the waste,

and provide that the flow of water would not exceed the pumping capacity of the pit.

*Answer.*—The enclosed sketch illustrates the methed I would adopt, provided other conditions were favourable. Supposing the system of working were longwall, I would stop the wide work when a point had been reached within about 50 yards of the waste, and commence, at once, driving two strett place about six feet wide. I would have a bore-hole in the centre of place, and a flank bore-hole on each side. The centre hole I would have at least 10 yards in advance, and the flank holes, which should make an angle of forty-five degrees with the centre hole, I would have not



less than 15 yards in advance. Very much, however, would depend on the nature of the coal—the softer the coal, and the longer the bore-holes. Pitchpine plugs about three feet in length, with an iron band at the head, must be kept in readiness. The moment the water is tapped all the holes but one must be plugged up. Into the one left unplugged a pipe a little less in diameter than the hole, having a tap at the outer end should be inserted (which should have been kept on the spot in readiness for use) and plugged and corked tight round its sides with long plugs, so as to ensure its being watertight. From this pipe the water may be conveyed to the place from which it has to be pumped and run off as required.

WILLIAM LITTLER,
234, Woodhouse Lane,
Wigan.

*Question* 10.—Describe efficient methods of attaching flat and round wire ropes to drums and to cages, and the proper measures to be taken for preserving and ensuring the safety of wire ropes.

*Answer.*—The rope is secured to the drum of a winding engine as follows:—A hole is bored through the barrel of the drum, and the rope passed two or three times round the shaft of the drum. The loose end of the rope is brought to the other part, and it is clamped together by efficient clamps. Care must be observed when passing the rope through the barrel of the drum not to bend the rope at an acute angle, but to give it a uniform curve. The rope is attached to the cage by means of a strong cap or socket. The rope is inserted into the socket, carefully lapped with tarred rope, and the jaws of the socket brought firmly together. Several hoops of iron are heated aud put tightly over the socket, and as the hoops become cool they contract, and clip the socket more tightly. Winding ropes can be preserved in many ways, and the observation of these various modes of preservation will greatly prolong the life of the rope. The position of the drum in relation to the pulleys should receive careful consideration. They should be so placed that the inclined portion of the rope does not make a very acute angle with vertical, say 45 degrees, as the bending of ropes is not to be desired where it can be dispensed with. When the day's work of the pit is ended, the cages should never be allowed to always stand in the same place, as the bending strain is always on the same place, as also is the suspending strain between the pulley and cage. Cages with loads should never be allowed to hang in the shafts. Moisture greatly destroys winding ropes, hence care must be taken to completely isolate the rope from water by covering it wherever possible. Ropes must be oiled every week with a special oil called rope oil, which not only preserves the rope, but by its application considerably reduces the amount of friction on the pulleys. Ropes should not be strained by too heavy loads. To provide against this the various strains, resistance, and load should not be more than one-ninth of the tensile strain of the rope.

G. A. HAWES,
Holy Trinity Terrace, East Murton.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### Suggested Enlargement of "Mining."

Sir,—I am in full sympathy with your correspondent in regard to your journal that

more room is required for correspondence of a pen and ink debating class, and "Mining" taken from a miner's point of view is to my mind the best all round journal of its kind, especially if you take the price into consideration. This being so, it is my greatest desire to see its prosperity. Now, to come to the point, I will, if you will allow me, make a suggestion that it should be published weekly (if possible) instead of fortnightly as at present. By so doing the present price will still be maintained, thus the desire of the editor will be gratified; also a good many advantages will be obtained by the reader. I will mention only a few out of the many which I think will be seen without much consideration:—1st, more room for correspondence and debate. 2nd, more room for articles, lectures, etc., on different subjects. 3rd, more room for the advertisements of the leading mining works, etc. 4th, the price will still be maintained. 5th, double the space will be provided. 6th, lastly, and most of importance, it will keep the reader in closer touch with his work if he receives the journal weekly instead of fortnightly. Hoping this suggestion will be ventilated both by editor and reader of this journal, and at the same time excuse me for trespassing on the little space which is provided for correspondence.—I remain, yours sincerely,

Thos. Rushton.

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Dear Sir,—Having read Horace Rowley's invaluable letter in this week's journal, I for another one of your readers agree with him that something must be attempted to enlarge your most excellent publication. But I do not agree with him when he says that readers of the twopenny numbers should pledge themselves to take it. I am afraid that the circulation would not increase very much, for where one agrees the other may not; besides, the object of the journal is "cheapness." What I should advise is to have two editions —a penny edition exactly the same as the present numbers, and a twopenny edition containing extra articles and correspondence, together with the penny edition. In this way a reader could take in the edition his means could afford. The only differences between the two editions would be one contained more reading than the other and the price. Then "Mining" would still be the cheapest mining paper published.—Yours truly,

W. D. Harbit.

P.S.—I have endeavoured to make this letter as short as possible. I have tried my best to solve this great difficulty, and I hope you will *publish it, if possible*, as I think it is *important to all readers*. I also hope I have not intruded on your space.

---

### Inclination of Seams from Boreholes.

Sir,—Would you kindly insert the following question in your valuable journal, hoping that some of your readers will answer, for which I shall be extremely obliged?

Three pits—A, B, C—are 80, 100, and 60 yards deep. From A to B is 500 yards, and A to C 1,000 yards, and B to C 800 yards. Find area enclosed and inclination, also level course of seam.—Yours,

A Constant Reader.

---

### H.P. of Engines.

Sir,—Kindly enter this in your valuable paper.

Suppose the diameter of a cylinder to be 55 inches, travelling 200 feet per minute with 7lbs pressure on the piston, what is the nominal horse power? J. Moore.

---

### Mine Gases.

Dear Sir,—I notice in Mr. Davies' answer to the question on firedamp C. H., he gives the specific gravity as 559, which, I think, should read as 562. Also that 1% of gas when mixed with 15% of air is ignited with a naked light the result is a violent explosion. According to Mr. Atkinson and others the force of the explosion would be very feeble when 1% of firedamp is mixed with 13% of air; and it is at its greatest explosive point when mixed 1% of gas to 8 or 9 of air.

Trusting you will correct it, yours truly,

T. Burford.

## ANSWERS TO CORRESPONDENTS.

Mining Student (Westhoughton).—The Science and Art Examinations in Mining consist of a written paper only, and the C.M.R.A. and special rules are not included. We can scarcely give a list of the subjects necessary for the advanced stage as only one list is given in the syllabus for the three stages in this subject, and that is far too large to be published here. For other information see other parts of this issue.

J. Hartley.—It should be possible to obtain "Mining" upon the same Saturday as the paper is dated. Yes, all back numbers may be had from this office.

Reader (New Zealand).—We are pleased to know our paper is read so far away from home; and that our humble efforts are so highly appreciated.

Printed and Published by Strowger and Son, Clarence Yard, Wallgate, Wigan.


No. 11. Vol. II. SATURDAY, APRIL 21, 1894. FORTNIGHTLY ONE PENNY.

**CONTENTS**



# MINING LECTURES

BY C. LATHAM,

Lecturer to the County Council and University of Notts.

*(Specially written for this Journal.)*

Commenced in No. 8, Vol. II.

## No. 1 CONTINUED.

## COAL: ITS HISTORY, COMPOSITION & USE.

WE have now shown how the vegetable matter forming coal grew, but we have still another question to solve, and that is:—

How did this vegetable matter become buried? It grew at the Earth's surface, but we don't find our coal there. No, in many cases, hnndreds of yards below, and, in order to account in a satisfactory manner for the position it now occupies, we require to turn our thoughts in the direction of certain actions which have taken place in the past, and are still, although in a much smaller degree, taking place at the present day. It is, I think, a fact well known to most of us that the level of the Earth's surface on which we live is constantly changing, in some cases rising and in others falling, due to some unseen agent of nature.

Let us look for a moment at the sea shore. In many cases we now find what was, twenty or thirty years ago, dry land, entirely covered with water; in other places the sea is slowly retreating, and leaving behind it vast areas of dry land.

What does this show?

That in the first cases the land level is falling, and in the others rising, and although we find the rates at which these changes take place very slow at the present day, there is very little doubt that in the past it was not so, but much more rapid. Again, by the study of geology, we find that change in level has, in a large number of cases, been brought about by earthquakes and volcanoes, both of which were very numerous during the coal period. The action of running water, snow, frost, &c., have all played their part in reducing and building up land surfaces.

Let us take a large area of decaying vegetable matter, similar to what we described in the last chapter, situated on low-lying land near the sea. Slowly the whole surface has subsided, forming a basin. Into this basin either the water from the sea or some river has rushed, carrying along with it large quantities of fine material. The water has become stationary, and deposited, in one even layer over the vegetable matter, the fine material it brought along. This action has gone on year after year, perhaps century after century, until, either from the large amount of sediment deposited or from the rising of the land, the basin has become full, forming a new land on the surface. On this we have had another accumulation of vegetable matter and in time, another depression. Water has flowed into the basin so formed, depositing its fine material and filling up the basin. Again and again have similar occurrences taken place, until at last the first layer of

vegetable matter has become covered by an enormous thickness of fine material. It is to this action then that we owe our coal seams. First a land surface, then a basin, another land surface, another basin, and so on, time after time.

How does vegetable matter become coal?

When vegetable matter is subject to heat and pressure but excluded from air, it undergoes a chemical change. First it looses carbonic acid and water, becoming converted into peat. On a further loss of carbonic acid and water peat becomes lignite; still loosing carbonic acid and water lignite becomes coal, and so on, right to anthracite. This then is what has taken place when our vegetable matter was covered by hundreds of thousands of tons of overlying material, material which itself has undergone vast changes, becoming shale, sandstone, etc., by the same agents which transformed the vegetable matter into coal.

How long has it taken to build up our coal-fields, or even to form one single seam, is a question which we are unable to answer. Of geological time we can form no idea, but there is every reason to believe that hundreds of thousands, perhaps millions of years were occupied in the process, and we leave it to our readers to choose their one time, let it be long or short, as fancy may direct..

### Blending of Coal Seams.

It sometimes happens if we trace a seam of coal over a large area we find that although at the point we started from we had only one seam, yet, when we have followed it some distance, it becomes two, three, or even more seams, separated one from the other by various thicknesses of shale, sandstone, etc. This action is known as the blending of coal seams, and is accounted for as follows:—Suppose we have a large tract of vegetable matter, half of which is slowly depressed, leaving the other half in its original position. The basin so formed becomes full of fine material, until we have again one level surface, half vegetable matter and half deposited material. Over the whole area we have a second growth of vegetation, followed by, it may be, a depression of the whole tract. In this case, when the basin becomes full we shall have at one part (the one first depressed) two seams, and at the other part only one seam, the total thickness of the latter being equal to the combined thickness of the two former. A very good example of this is the ten-yard seam in Staffordshire, which in some parts is one clear seam of good coal, whilst in others it is split up into quite a number of seams, and in some cases lying considerable distances apart, owing to the amount of material deposited between each depression.

### Use of Coal.

It is now necessary for us to say a word or two regarding the use of coal, because although one coal will serve very well for some purposes it would not be in any way suitable for another. The chief uses of coal are first

### Metallurgical Purposes

the chief of which is iron manufacture, and in this class of work we want a coal free from iron pyrites, which is a mixture of iron and sulphur, the sulphur giving very bad properties to the iron. It must give great heat, hence it must contain a large amount of carbon. It must be a strong coal not easily made into slack, because if, when subject to the heavy weight of metal in the furnace, it is crushed into small, we shall have the draught of the furnace made up, and, as a result, shall do no work. It should not coke for the same reason, and all impurities and water it contains are so much loss, the former making ash, and the latter requiring a large amount of heat to drive it away as steam.

### Steam Coal.

This is probably the most important use to which coal is put, and it should possess most of the properties named above, although such an intense heat is not required. It should contain little sulphur, ash, or water, and must be strong and non-coking, or we shall have considerable loss owing to the small falling through the fire-bars and the coke interfering with the draught.

### Domestic Uses.

Possibly in this we are more interested than any other, and a good household coal should be clean itself, and make little or no ash in burning. It wants to be fairly strong so as not to crumble to dust. It should light easily and burn with a bright flame, requiring only a light draught. Should cake slightly, so as to throw heat into the room instead of allowing it all to pass up the chimney.

### Gas-Making.

The chief point in gas manufacture is that the coal must contain a large amount of gas, and should this be so, then most other evils can be overlooked, as they can easily be got rid of by chemical means. At the same time it is well to choose a coal which gives the greatest quantity of gas with the least amount of labour.

*End of Lecture 1.*

## THE SCIENCE AND ART EXAMINATIONS.

*Continued from last issue.*

### ELEMENTARY.

*You are anly permitted to answer Seven Questions. Time allowed is Three honrs.*

The following are the Elementary Questions given last year (1893).

(1) What is a mineral vein or lode, and how are ores or useful minerals usually found in it?

(2) What kinds of metallic ores and other useful minerals are usually found in stream works or alluvial deposits?

(3) What are bituminous, free-burning, and smokeless coals? Give an example of each.

(4) When a coal seam is cut off by a fault, what operations are necessary to prove the throw?

(5) Describe a method of long-wall working on a thin seam with a good roof.

(6) Give a sketch of a method of securing a level with timber.

(7) Describe the principle of main and tail rope haulage underground.

(8) What gases are met with underground, and to what extent are they dangerous in the air of mines?

(9) How is the circulation of fresh air kept up through the workings of a large mine?

(10) Describe the principle of the safety lamp, and the construction of one of the safest forms.

(11) How can air be carried to the fore breast or end of a level?

(12) Give a sketch of the methods of stoping on a lode, and passing the mineral to a level below.

## ANSWERS TO CORRESPONDENTS.

I. S. (Leeds).—We are very sorry we cannot comply with your request, for the simple reason that we do not keep unsuccessful contributions to the Competition Questions. Had you notified us of your wish at the same time the contribution was sent in we would have been pleased to return sketch.

Surveying Apprentice (Glam.).—We are pleased to know you are deriving great benefit from the surveying articles. You cannot do better than work out for yourself the numerous examples given.

J. Kilton.—A description of the Fleuss apparatus appears in this issue. Always glad to oblige readers.

Elementary Student (Wakefield).—If you do not attend the lectures at one of the Science and Art Department centres you should have made application before March 20th to the local secretary for a seat at the examination. If, however, you go to the rooms on the night of the examination you may be able to take the place of some candidate who has not turned up.

W. H.—We are glad to hear that you think our paper is a valuable one and also that you have become one of its competitors, because by doing so it enables you to put your ideas down more clearly on paper as you gain experience in writing; every one cannot obtain the prize, but we think it improves a man very much by competing regularly, because he becomes so accustomed to writing out his ideas with care and clearness, which he could never have done otherwise. You can change your stage each week if you desire, but must keep to one stage in each issue. You should compare your answers with the successful ones, and we have no doubt you will be able to pick up many suggestions therefrom which will enable you to make some improvement if you will only persevere.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### HYDRAULIC ENGINE.

Sir,—I would be very much obliged to any of the readers of your valuable mining paper for an answer to the following, viz.:—Where does the Hydraulic engine get its power from and how does it apply its power. An answer would be thankfully received.—Yours, George.

### SURVEYING.

Sir,—In answer to B. C. queries in No. 9 I offer the following:—

1. *Parallax* occurs with a level and gives rise to errors if disregarded; it cannot be allowed for. To grasp clearly what is meant by parallax it must be

understood that the object seen through a levelling instrument is not seen by direct rays, but is the image formed on the object glass. If this image does not fall exactly at the place of the cross-wires parallax occurs. It may be corrected by moving the sliding tube in or out by means of the milled-head screw until the proper focus is obtained. The existence of parallax is detected by the wavering appearance of the image when the head is moved from side to side.

2. *Collimation* is the line of sight in a telescope or level. The circular brass diaphragm containing the wires is known as the collimator, and the adjustment of these wires in the proper line of sight is effected by the small collimating screws fitted to the diaphragm. The collimator is fitted in its proper position by the instrument makers, and the instrument should be sent to them if the collimator requires adjusting.

3. *Logarithms* may be worked out without reference to the table by algebra, but unless B. C. has a lifetime to spare I should advise him not to attempt it. Obtain a good book on logarithms for other information as the explanation would be too long for this correspondence.—SURVEYOR.

MECHANICS.

Sir,—In answer to R. COCKBURN, the following solutions will, I think, enable him to see clearly the method adopted in working all such examples.

(1) A train weighs 80 tons, and its speed is 40 miles per hour on a level rail; find h.p. of engine. If the gradient was 1 in 100, and the engine exerted the same power, find the speed of train.

A carriage upon a railway only requires a pressure of $\frac{1}{280}$th part of the weight to give it motion, or about 8 lbs. per ton. This is called the co-efficient of friction. Therefore, resistance of friction $= 8 \times 80 = 640$ lbs. Distance moved in feet per minute $= \frac{40 \times 5280}{60} =$ 3520 feet. Work of friction per minute $= 640 \times 3520 = 2252800$. Now, as the speed of the train is uniform, the work of the resistances will be equal to the effective work of the engine. Therefore, h.p. of engine $= \frac{640 \times 3520}{33000} = 68{\cdot}26$.—*Answer.*

In the second part of this question say we have a rise in gradient of 1 in 100, the same power only to be exerted. Here we have not only to account for work due to friction, but also work due to gravity as well. Rise of rails is 5280 feet or 1 mile $= 52{\cdot}8$; therefore—

Work due to gravity $= 80 \times 2240 \times 52{\cdot}8 = 9461760$
Work due to friction $= 80 \times 8 \times 5280 = 3379200$
Total work done in 1 mile $= 12840960$

Work of the engine per hour $= \frac{68{\cdot}26 \times 33000 \times 60}{9461760 + 3379200} =$ 10·5 miles per hour. Therefore the speed of train would be 10·5 miles per hour under the conditions named

(2) An engine of 100 h.p. ascends a gradient of $1\frac{1}{4}$ in 100, at a speed of 20 miles per hour. Find weight of train.

Work of engine per hour $= 100 \times 33000 \times 60 = 198000000$.

Work consumed in friction per hour in moving
1 ton $= 8 \times 20 \times 5280 =$ 844800
Work consumed in gravity per hour in moving
1 ton $= 2240 \times 52{\cdot}8 \times 1{\cdot}25 \times 20 =$ 2956800
Therefore, work consumed per hour $=$ 3801600

Therefore, number of tons $= \frac{100 \times 33000 \times 60}{844800 + 2956800} =$ 52·08 Tons.—*Ans.*

(3) A body weighing 8 cwts. is drawn along 100 feet of an incline which rises 2 feet in height for every 5 feet along the plane, the resistance of friction being neglected. Find work done.

Work done equals product of the weight in pounds by the vertical height in feet. Therefore, $8 \times 2 \times 40 = 35840$ work done in foot pounds.—*Answer.*

(4) A car laden with 20 passengers is drawn up an inclined plane, one end of which is 160 feet above the other. The car when empty weighs two tons, and the average weight of each passenger is 140 pounds. Find the number of foot pounds of work done in ascending the incline, friction being neglected.

The same rule applies to this as question 3.

Weight of passengers $= 140 \times 20 =$ 2800
Weight of car $= 2240 \times 2 =$ 4480
Total weight $=$ 7280

Number of foot pounds $= 7280 \times 160 = 1164800$.
1164800.—*Answer.*

W. Harlington.

# EDITORIAL CHAT.

HAVING received a large amount of correspondence (a portion of which we have published) from our readers, suggesting an enlargement of our Journal and a corresponding increase in the price, we consider that there is some explanation due to our subscribers of our intentions in this matter. Our first duty is to heartily thank our numerous correspondents for their advice, suggestions, and good wishes for the success of our paper. The majority of them are of the opinion that a little more matter and an increase in the price would prove more satisfactory. We, however, do not feel disposed to follow this suggestion, as we would (as one of our correspondents remarks) be thus defeating the original object of our Journal.

We have, however, made some alterations in the type, thereby giving more matter. Several issues ago we drew our readers' attention to the fact that we had reduced the size of the type in the Answers to Competition Questions, and since that time we have printed several other parts of the paper in the smaller type. We are still short of space, as many of our correspondents know when they do not see their communications published. We have, however, so arranged the printing, and reduced the size of the type, that the difficulty with regard to space will be alleviated, at least for the time being. Especially is this the case with the portion of the paper devoted to the use of our correspondents. By comparing this issue with some of the first nnmbers, our readers will perceive at a glance the great difference. The amount of matter published is *more than double*. This has been effected, it is true, without increasing the number of pages. But, we presume that it is not the number of pages our readers consider, so much as the increased amount of matter.

It will of course be readily understood that the new arrangements must necessarily increase the cost of production, and we hope to gain the co-operation of our readers in our behalf.

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

(*Continued from No. 10, Vol. II.*)

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

### Subject.— SURVEYING AND GEOLOGY.

QUESTION 6.—Illustrate, by sketches in ink, the way in which coal seams are often "thrown" by faults and igneous dykes, and explain the common effect of such faults and dykes upon the adjacent coal.

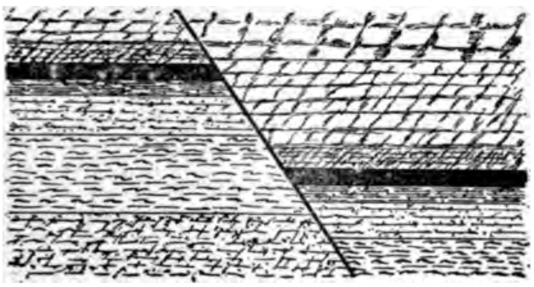


Fig. 1.—Ordinary Fault.

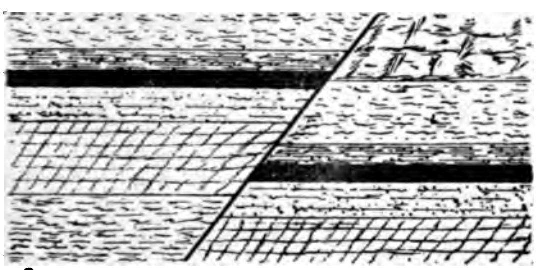


Fig. 2.—Reversed Fault

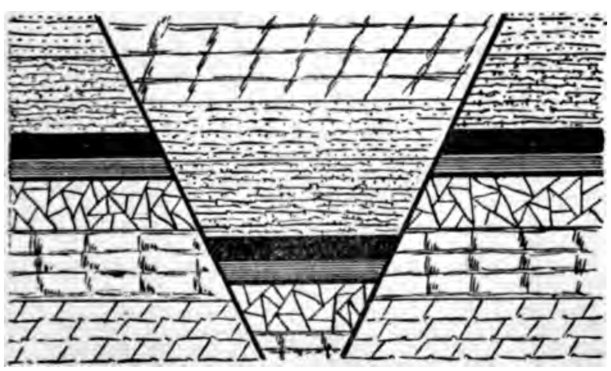


Fig. 3.—Trough Fault

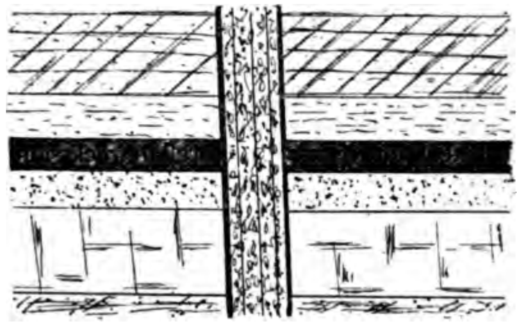


Fig. 4.—Dyke without Dislocation of Strata.

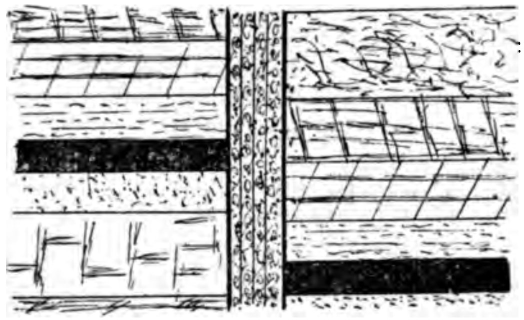


Fig. 5—Dyke Dislocating Strata.

ANSWER.—An ordinary fault (Fig. 1) is termed an up-throw or a down-throw according to the side upon which it is approached, the coal being thrown up or down from that side. In a reversed fault (Fig. 2) the coal is thrown in the opposite direction to what we should expect to find it. Trough fault (Fig. 3) consists of a pair of faults dipping towards each other, and the coal is thereby thrown into a kind of trough. The effect these faults have on the adjacent coal is that for a few yards on each side the coal is of an inferior nature. Dykes (Figs. 4 and 5) consist of wall-like masses of basaltic rock which traverse the coal-seams and their accompanying shales and sandstones. They are chiefly composed of what is variously known as gneiss-rock, whin-stone, toad-stone, trap, etc. Very frequently the dykes occur similar to a fault and the strata is dislocated. They have a very injurious effect on adjacent coal, as they are very frequently accompanied by cindery or bad coal, and beds of coal traversed by dykes are often injured to a considerable distance.

QUESTION 7.—Name the geological systems of rocks from the Oolite to the Cambrian.

ANSWER.—Oolite and Siassic, Triassic, Permian, Carboniferous, Devonian, Silurian, and Cambrian.

Question 8.—Describe the chief characteristics of the Carboniferous system, and name the fossil remains you have seen in the coal measures.

Answer.—The Carboniferous system is composed of the carboniferous limestone, and next above are the yoredale rocks and then millstone grit, and, on top, coal measures. It is one of the most economic systems, its useful products being first the coal seams, and then iron, lead, zinc, and fire-clay. Also stone for building, decorating, paving and roofing, the lowest bed, the carboniferous limestone, lying quite conformable with the old red sandstone and the top bed coal measures. The fossils I have seen are chiefly in the coal measures, namely, sigillaria, stigmaria, lepidodendron, and pine fir.

Question 9.—State what is the t position of the carboniferous limestone relation to the coal measures, and ment an exceptional case in England where a la area of carboniferous limestone is founc connection with the coal measures i contrary order as to position.

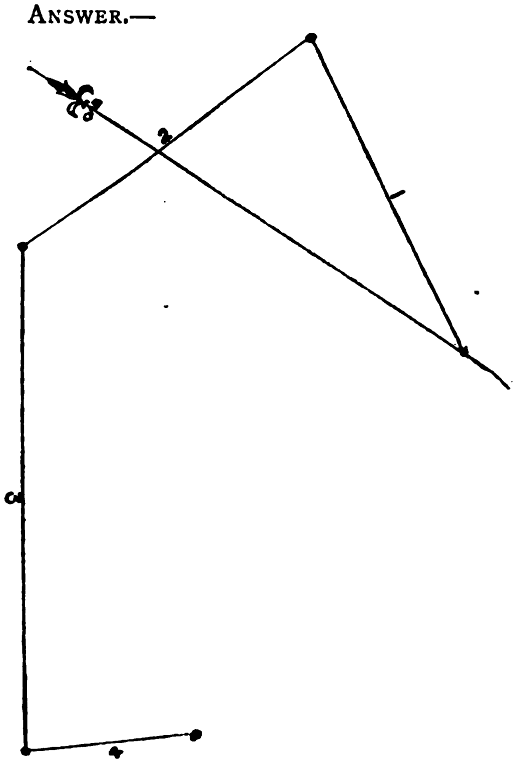
Answer.—The true position of carb iferous limestone in relation to coal measu is (beginning at the bottom) carbonifer limestone, millstone grit, and coal measu There is an exception to this case Northumberland, where several beds of c are found at the base of the carbonifer limestone.

## Surveying.—(Plotting.)

Question 10.—By means of instruments provided plot the following survey on paper, to a scale of two chains to an inch:—

| BEARINGS. | LINKS. |
|---|---|
| N. 30 degrees 45 minutes E. | 1,110 |
| N. 70 degrees 00 minutes W. | 1,135 |
| S. 53 degrees 15 minutes W. | 1,610 |
| S. 41 degrees 00 minutes E. | 540 |

Answer.—



*Sketch has been drawn 6 chains to an inch to suit our columns..*

Question 11.—Show how you would w out the following levels taken off a field-bo

| Back sight. | Fore sight. | Rise. | Fall. | Reduced le |
|---|---|---|---|---|
| 11·95 ... | 9·77 ... | ... | ... | |
| 9·77 ... | 4·18 ... | ... | ... | |
| 4·88 ... | 1·94 ... | ... | ... | |
| 1·94 ... | 4·08 ... | ... | ... | |
| 12·05 ... | 5·05 ... | ... | ... | |
| 5·05 ... | 5·72 ... | ... | ... | |
| 5·72 ... | 1·92 ... | ... | ... | |
| 1·92 ... | 2·73 ... | ... | ... | |

Answer.—We will take the datum at 5( then the levels work out as follows:—

| Back sight. | Fore sight. | Rise. | Fall. | Reduced le |
|---|---|---|---|---|
| 11·95 | 9·77 | 2·18 | | 52·18 |
| 9·77 | 4·88 | 4·49 | | 57·07 |
| 4·88 | 1·94 | 2·94 | | 60·01 |
| 1·94 | 4·08 | | 2·14 | 57·87 |
| 12·05 | 5·05 | 7·00 | | 64·17 |
| 5·05 | 5·72 | | 0·67 | 64·20 |
| 5·72 | 1·92 | 3·80 | | 68·00 |
| 1·92 | 2·73 | | 0·81 | 67·19 |
| 53·28 | 36·09 | 20·81 | 3·62 | 50·00 |
| 36·09 | | 3·62 | | 17·19 |
| 17·19 | | 17·19 | | |

The levels are checked by adding back sights and fore sights, then subtract least from the greater, and the differe gives the rise or fall, as the case may

53·28 (back sight) — 36·09 (fore sight) = 17·
20·81 (rise) — 3·62 (fall) = 17·19
67·19 (reduced level) — 50·00 (datum) = 17·

Therefore, we have a rise of 17·19 fr starting point.

*(To be continued.)*

## RESPIRATORS

### For Penetrating Noxious Gases.

The value of an apparatus that enables persons to enter noxious gases and remain in them for a period of several hours will be apparent to all who have taken any part in attempting to rescue the imprisoned or suffocating men after an explosion, or in arranging the ventilation, etc., afterwards. The first serious attempt to make an apparatus to effect this was by Mr. J. Hutchinson, M.D., in 1849. The method he proposed was the carrying on the back of the person about to enter the gases a bag containing four or five cubic feet of air, and by means of a mask and a suitable arrangement of pipes and valves the air could be inhaled from the bag and the foul air expelled into the atmosphere. Several other suggestions have been made since that time such as the laying down of a series of pipes along the main roads; these pipes, when necessary, to be used as a means of sending fresh air to explorers. The most ingenious device and the only one up to the present which can be called successful is the Fleuss Respirator. It has given very satisfactory results on more than one occasion, and has been the means of saving life and a considerable amount of property. In 1880 it was used for exploration at the Seaham Colliery after the explosion, and one man on this occasion used the apparatus for two consecutive hours. At Killingworth Colliery it was used for the purpose of saving life, and with some slight modification has been used under water, when the ordinary diving dress has failed—notably in the case of the Severn Tunnel.

The following is the Inventor's description of the apparatus:—

"The principle of the apparatus is that the wearer breathes his own breath over and over again, the carbonic acid being absorbed from it at each expiration, and the requisite amount of oxygen restored, the revivified breath is fit to be again inhaled in the form of pure air.

The apparatus, which is carried upon the back of the diver or explorer, consists of a strong sheet copper cylinder, 12 inches by 6½ inches, with domed ends, and capable of holding four cubic feet of oxygen gas at a pressure of 16 atmospheres. Above the cylinder, and attached to the side of it, is a square metal box, 12 by 12 by 4 inches, to contain the carbonic acid filter, which is a box of vulcanite, divided into four compartments, and with a wooden lid made air-tight by an india-rubber washer, and having an inlet and an outlet tube; this box is filled with a packing of ordinary tow, interspersed with two pounds of stick caustic soda; the exhaled breath passes twice up and down through the interstices of the tow, by which it is finely divided and thoroughly freed of carbonic acid by the caustic soda, the excess of moisture collecting under a perforated false bottom arranged for the purpose.

**The Fleuss Apparatus.**

A flat bag of vulcanized india-rubber is fastened to the apparatus, and is connected by an india-rubber pipe over the shoulder to the outlet pipe of the filter; the bag is also in communication with the oxygen chamber, and the supply of oxygen to the bag can be regulated by a jamb screw valve under the control of the wearer.

An india-rubber mask is made to fit air-tight to the face, and is held in place by straps buckled up at the back of the head; the mask is fitted with a pair of flexible

valved pipes, the one for exhaling being in communication with the inlet pipe of the filter, and the other for inhaling in communication with the air bag.

The exhaled breath having passed through the filter enters the bag in a purified state, and there meeting with its complement of oxygen is fit to be again inhaled. The bag being perfectly flexible readily expands or contracts as the breath passes in or out of it, so that no effort is required in respiration."

It has been found that a Demayrouse mask is more comfortable and works better than the original Fleuss mask.

A safety lamp was also patented to be used in conjunction with the respirator, but as there are several portable electric mining lamps in the market at the present time, which will answer the same purpose, a description of the lamp is not necessary.

## COMPETITION QUESTIONS.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

1.—All envelopes must be marked "COMPETITION."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by April 28th, 1894.

### ELEMENTARY.

*Question* 1.—Describe with sketch the square method of working thick seams of coal.

*Question* 2.—What is the operation known as *holing* or *kerving* in coal mining. Give sizes and weights of tools employed.

*Question* 3.—What are clayband ironstones, how do they occur, and what methods are adopted for working them.

### ADVANCED.

*Question* 4.—Describe how water is raised from mines by tanks. Describe with sketch an automatic working tank suitable for the purpose.

*Question* 5.—Describe the Longwall method of working coal in two of its varieties.

*Question* 6.—What are the principal methods in use for signalling from the bottom of a deep mine to the surface, and of indicating the position of the cage in the shaft ?

### FIRST-CLASS.

*Question* 7.—Describe with sketch how you would proceed to re-open a roadway which has fallen to a considerable height.

*Question* 8.—How would you arrange the winding in a pit with two mouthings at different levels; coal being wound from both ?

*Question* 9.—It has been decided to use water jets in the main haulage road of a dusty mine to avoid the risk of a coal dust explosion. Show with sketches how you would arrange the water pipes and what arrangements would you make to obtain fine sprays.

*Question* 10.—Describe with neat ink sketch the lifting gate fence for the surface landing of a two cage shaft.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

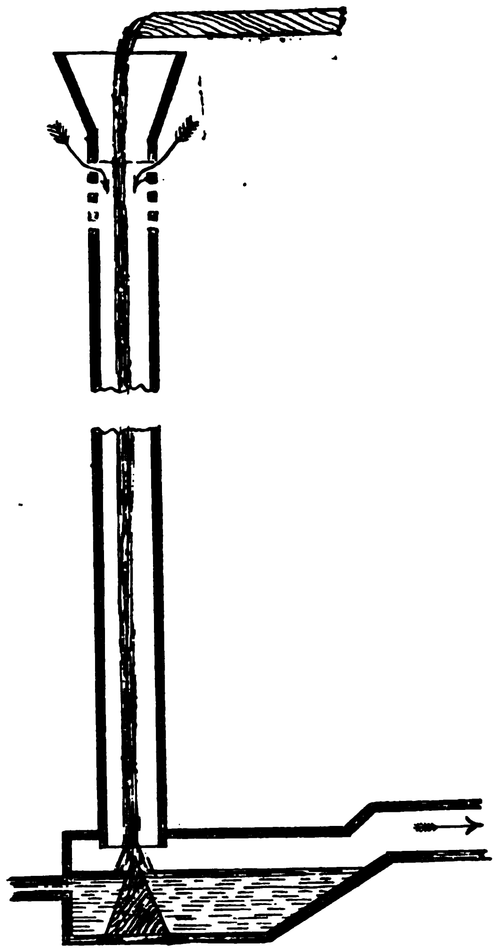
## ANSWERS TO QUESTIONS

In No. 9, Vol. 2.

### ELEMENTARY.

*Question* 1.—Describe the water blast or trompe, and give a sketch showing its mode of action.

*Answer*.—Where there is a supply of water at the surface, and a water level to carry away the water, the water blast or trompe may be used with pretty good effect. As can be seen in the accompanying sketch, it is the action of falling water that produces a current of air to pass along. Its mode of action is as follows:—The water entering the hopper by the launder, passes through a network of wire mesh, or upon dash boards, thus causing the water to fall in a fine spray which, in falling, carries the air with it, the supply of air passing through the perforations at the side. The water falls into the



tank, the released air passes through the pipe, and the water through the overflow pipe. The pipe which conveys the air is carried forward to the end of the level, so that a long level could be ventilated by this method.

ALBERT HY. MEAKIN,
Mansfield Road,
Eastwood Notts.

*Question* 2.—In what manner can coals be classified according to their relative ages?

*Answer.*—The different kinds of coal may be classified as follows, by contrasting their difference in composition, nature, quality, &c. We class the varieties of coal under four principal headings, thus:—

(*a*)—LIGNITE, or Brown Coal, is the youngest variety, or first stage, in the peat vegetation, &c. It has a woody texture, varies in colour from brown to nearly black, and burns pretty freely, but owing to the high percentage of water it contains, it has a very thick smoky flame and an unpleasant odour. It has a sp. gr. varying from ·5 to 1·4, and its mercantile value is inferior to that of any other coal. It is found inter-stratified with the latest or newest rock formations, such as the tertiary series (Bovery Tracey, Devonshire). Also, lignites of Yorkshire occur in the middle eocene formation; it is found in the cretaceous and oolitic rocks. The lignites have not had time to attain that perfection or development which the older coal-fields have undergone.

(*b*)—BITUMINOUS. This kind of coal is chiefly found in the true coal measures, generally called the caking and non-caking variety. Different seams in the same coal-field vary in richness and volatile matter. It is usual to divide them into three classes. (1) The clear-burning; sp. gr. 1·53. (2) The flaming or caking; sp. gr. 1·33 (this is excellent for coke-making). (3) The fulginous; sp. gr. 1·26. The gas obtained from this division is abundant, and of a high-class illuminating power. In composition it contains from 70% to 90% of carbon, and from 8% to 22% of nitrogen, hydrogen, and oxygen. It is next above the anthracite in geological order, as a rule. Lignite, by age and time in the mode of preservation, slowly changes into bituminous coal, and cannel coal appears to be nearly of the same age as the bituminous seams.

(*c*)—The CANNEL COAL varieties are generally considered to represent an intermediate stage of change in chemical composition which has resulted in the conversion of lignite into bituminous coal, and hence it is usually found to occupy a corresponding position in the coal strata. Its composition is from 70% to 80% of carbon, 8% to 12% of oxygen, 5% to 10% of hydrogen, 2% nitrogen, and 3% to 7% ash. Its sp. gr. is 1·27.

(*d*)—ANTHRACITE is the ultimate product of vegetable matter into coal. Its structure is homogenous, its density is greater than other coals, and it has a much more mineralized appearance. It is further distinguished by its high sp. gr. (1·50), and large proportion of carbon (from 90% to 95%). Therefore, it has the greatest heating power, but volatile matter only in minute quantities. Hydrogen, oxygen, and nitrogen from 2% to 3%., and ash about 3%. Res-

pecting the anthracite, there is one exception which occurs in the South Wales coal basin. The seam of coal changes from the bituminous to the anthracite, or rather, where the seam is near to the bassett or out-crop, it is of a bituminous kind, and at the dip point or centre, where it is beneath a thicker superincumbent strata or cover of the rocks, it is discovered that the seam becomes more and more of an anthracite nature with the depth. It has been more subjected to metamorphic agencies than the seams above it, and it has undergone a greater amount of change than any other coal.

SAMUEL DAVIES,
Park Road View,
Worsbro' Bridge,
near Barnsley.

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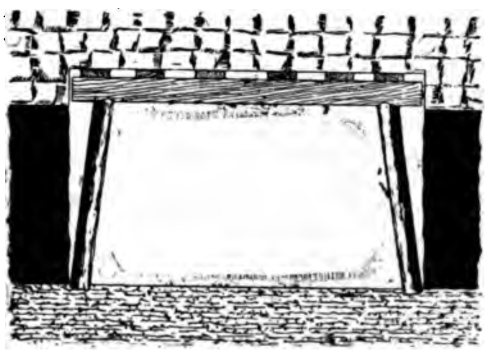
*Question* 3.—Describe, with sketch, how you would timber a level in coal with a hard bottom and soft roof.



*Answer*.—The accompanying sketch shows what I think would be the best method to timber a level of coal with a strong floor and soft roof. Props of Norway wood are fixed at intervals of about one yard on each side of the road, and cross-bars are fixed on the top of these props from one side to the other, the bars being notched to fit the props. This is done to hold them in position. Over the top of the cross-bars are placed a number of battens about one foot wide and six feet in length, to support the roof between each bar.

ALBERT HY. MEAKIN,
Mansfield Road.
Eastwood, Notts.

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## ADVANCED.

*Question* 4.—Describe what arrangements are made in the tubbing of a shaft to let off any extra pressure of gas or water.

*Answer*.—The arrangement for the escape of gas or water which may accumulate behind the tubbing in the shaft is as follows:—After the tubbing has been all fixed, then comes the wedging of the joints and the centre holes, oak plugs being used for the holes, beginning at the bottom and proceeding upwards. Caution should be taken not to plug too rapidly, so that the water and gas may be allowed to escape freely above. The imprisonment of the æriform fluid might cause the bursting of a plate, or blow out the sheathing at the joints. To avoid this a pipe is fixed from the upper course of segments to the next length of tubbing above, and again from that to the higher part. The gas and water will rise up this pipe and escape.

GEORGE DAYKIN,
24, High Gurney Villa,
nr. Bishop Auckland.

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*Question* 5.—How would you ventilate a sinking pit and the shaft bottom under the working scaffold.

*Answer*.—In ventilating a shaft during sinking operations, it would depend upon the plant which had been placed at the surface as to how I would ventilate the shaft bottom, but as steam power is applied during sinking operations, I would place sheet-iron pipes, two feet in diameter, down the shaft, as near the bottom as I possibly could do so as to be out of the way of the sinkers, with a small fan at the surface driven by steam power. In this way a good current of air may be produced, passing down the shaft and up the pipes to the fan. But, if an air compressor had been erected at the surface to work the drilling machines used in drilling holes for blasting purposes, I would connect sheet-iron pipes to the air-compressor, half the size of the pipes required for the fan, blowing cold air down to the shaft bottom, and in this way would clear away all noxious fumes and gases that are almost sure to be encountered when sinking.

HERBERT HALL,
15, Yardley Row,
Ryhill, Wakefield.

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*Question* 6.—State what is the chief portion of the carboniferous limestone in relation to the coal measures, and mention an exceptional case in England where a large area of carboniferous limestone is found in connection with the coal measures in a contrary order as to position.

*Answer.*—Taking this question from the geological point, we see after the deposition of old red sandstone the carboniferous limestone resting upon it; upon this comes the millstone grit, and then the coal measures resting upon this formation. The above come in the paleozoic group. The millstone grit is termed by the miners the "farewell rock," as no coal is found beneath it, except in the north of England, where the carboniferous limestone forms many high hills and deep valleys in the counties of Somersetshire, Derbyshire, Yorkshire and Durham, and it is frequently termed mountain limestone. According to *Fairley* we find the coal measures rest on the millstone grit, except at the west of Swansea Bay, where the millstone grit disappears altogether, and further west the coal measures rest on the lower silurian. The carboniferous limestone is largely quarried to burn into lime, and also to be used as a flux in iron smelting. It also contains valuable deposits of lead ore, zinc ore, and a little copper ore. Other products such as building stone, millstones, and flagstones are yielded by the carboniferous formation. GEORGE DAYKIN,

24, High Guerney Villa,
nr. Bishop Auckland.

## FIRST-CLASS.

*Question* 7.—Show how you work out the following levels taken off a field book:—

| Back sight. | Fore sight. | Rise. | Fall. | Reduced levels. |
|---|---|---|---|---|
| 11·65 ... | 9·77 | ... | ... | ... |
| 9·77 ... | 4·88 | ... | ... | ... |
| 4·88 ... | 1·94 | ... | ... | ... |
| 1·94 ... | 4·08 | ... | ... | ... |
| 12·05 ... | 5·05 | ... | ... | ... |
| 5·05 ... | 5·72 | ... | ... | ... |
| 5·72 ... | 1·92 | ... | ... | ... |
| 1·92 ... | 2·73 | ... | ... | ... |

*Answer.*—These are the levels worked out. I assume a datum of 40·00

| Back sight. | Fore sight. | Rise. | Fall. | Reduced levels. |
|---|---|---|---|---|
| 11·65 | 9·77 | 1·88 | | 41·88 |
| 9·77 | 4·88 | 4·89 | | 46·77 |
| 4·88 | 1·94 | 2·94 | | 49·71 |
| 1·94 | 4·08 | | 2·14 | 47·57 |
| 12·05 | 5·05 | 7·00 | | 54·57 |
| 5·05 | 5·72 | | 0·67 | 53·90 |
| 5·72 | 1·92 | 3·80 | | 57·70 |
| 1·92 | 2·73 | | 0·81 | 56·89 |
| | | | | 40·00 |
| 52·98 | 36·09 | 20·51 | 3·62 | |
| 36·09 | | 3·62 | | 16·89 |
| 16·89 | | 16·89 | | |

The levels are found in the following manner:—The backsights and foresights are subtracted from one another. When the backsight is greater than the foresight there is a rise, and, *vice versa*, when the foresight is greater than the backsight there is a fall.—(See rise and fall columns). A rise occurring first, it is added to the datum: 40·00 + 1·88 = 41·88. The two next being rises are added to this result, and then the fall occurring after these rises is subtracted from the result, and so on, the rises being added and the falls deducted. To check the levels, add all the backsights and all the foresights and subtract the smaller sum from the greater. This difference should equal the difference of the sums of *rises* and *falls*, and also should equal the difference between the last reduced level and the datum.

(*a*) Backsights — foresights = 52·98 — 36·02 = 16·89.
(*b*) Rises — falls = 20·51 — 3·62 = 16·89.
(*c*) Last reduced level — datum = 56·89 — 40·00 = 16·89.

HUBERT BRADSHAW,
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Swinton,
nr. Manchester.

*Question* 8.—Enumerate the noxious gases found in collieries, and state the composition of each.

*Answer.*—The noxious gases found in mines are five compound gases, viz.:—Light carburetted hydrogen gas, carbonic oxide, carbon dioxide, sulphuretted hydrogen, and hydride of ethyl.

*Light Carburetted Hydrogen* is the technical name given to what most miners call fire-damp. It is known to chemists as methyl hydride, and to miners in divers localities as fire, miners' enemy, fire-damp, and marsh gas. Its symbol is $C H^4$ which denotes it to be composed of one atom of carbon chemically combined with four atoms of hydrogen. It is found in most coal mines to some extent.

*Carbonic Oxide*, or *Carbon Monoxide* are the names given by chemists when speaking of the gas which is known to miners as white damp. Its symbol is $C O$ which signifies it to be composed of one atom of carbon chemically combined with one atom of oxygen. This gas is produced by incomplete combustion, such as gob fires.

*Carbon Dioxide*, or *Carbonic Acid.*—This gas is known in various localities by the following names:—Stythe, black-damp, choke-damp, and damp. Its symbol is $C O^2$ and it is composed of one atom of carbon combined

with two atoms of oxygen. This gas is produced by the breathing of men, and the various processes of combustion.

*Sulphuretted Hydrogen*, or *Hydrogen Sulphide.*—This gas is composed of two atoms of hydrogen chemically combined with one atom of sulphur, hence it is symbolised as $H^2S$. It is commonly produced in mines by the decomposition of iron pyrites or brasses in water.

*Hydride of Ethyl.*—This gas is known to miners as silver gas. Its symbol is $C^2H^6$ which denotes its composition to be two atoms of carbon chemically combined with six atoms of hydrogen. This gas is not often found in coal mines, but it is found in marked quantities in the cannel coals of Wigan and Scotland.

GEO. A. HAWES,
Holy Trinity Terrace, East Murton,
Co. Durham.

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*Question* 9.—A fan engine works at the rate of 80 revolutions per minute. The steam cylinder is 18 inches diameter; the stroke is 30 inches; the mean steam pressure on the piston is 40 pounds per square inch. Work out the theoretical horse-power of this single-cylinder engine.

*Answer.*—The following is the rule for finding h.p. of an engine:—

$$\frac{P\ L\ A\ N}{33000} = \text{theoretical horse power.}$$

Where P = pressure in pounds per sq. inch
,, L = length of stroke in feet
,, A = area of piston in sq. inches
,, N = No. of strokes per minute = revolutions × 2.

Applying the above we have:—

$$\frac{40 \times 2\cdot5 \times (18\times18\times\cdot7854) \times 160}{33000} =$$

theoretical h. p. = 123·379 horse power.

WILLIAM LITTLER,
234, Woodhouse Lane, Wigan.

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*Question* 10.—What size of hauling engine would be required to draw 100 tons of coal per hour up an incline of 1000 yards, with a gradient of 1 in 6?

*Answer.*—Assume an average speed of six miles per hour for set. Each full tub to weigh 15 cwt.; each empty tub 5 cwt.

$\frac{5286 \times 6}{60} = 528$ feet per minute speed of set.

$\frac{1000 \times 3}{5\cdot28} = 5\cdot6$, say six minutes to travel one way.

Allow three minutes for changing tubs, etc. Then $(6\times2) + 3 = 15$ minutes for double journey, therefore $\frac{60}{15}$ = four sets per hour, each hauling 25 tons of coal + one-half for weight of tubs $= 25 + \frac{25}{2} = 37\frac{1}{2}$ tons = 84,000 lbs., gross load of coal and tubs. Inclination = 1 in 6, therefore $\frac{84000}{6}$ = 14,000 lbs., nett load of coal and tubs.

A steel rope, seven pounds per yard, would be suitable for such a load. 1000 yards × 7 = 7000 pounds, gross load of rope. $\frac{7000}{6} = 1166\cdot66$ pounds, nett load of rope. Add $\frac{1}{28}$ of gross load of tubs and coal + gross load of rope, to the nett load of coal and tubs + nett load of rope, for friction. $\frac{84000 + 7000}{28} = 3250$ pounds allowed for friction, therefore $14000 + 1166\cdot66 + 3250 = 18416\cdot66$ pounds, total nett load.

Take diameter of drum as 6 feet, equals say 19 feet circumference. Then $18416\cdot66 \times 19 = 349216\cdot54$ foot pounds at each revolution of engine. Assume a 5-feet stroke, and an effective steam pressure of 45 lbs. per sq. inch on the piston. Then $\frac{546916\cdot54}{45\times5\times2} =$ 777·8 sq. inches = theoretical area of piston. Add one-half for general exigences. $777\cdot8 + \frac{777\cdot8}{2} = 1166$ sq. inches nearly. Or using a pair of engines $\frac{1\cdot166}{2} = 583$ sq. inches for each piston, therefore $\sqrt{\frac{583}{\cdot7854}} = 27$ diameter of each piston. I should use a pair of direct acting engines, 30-inch cylinders, 5-feet stroke. Average number of revolutions per minute, 28.

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Chevet View, Ryhill,
Wakefield.

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# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MINING STUDENTS.

No 12. Vol. II. SATURDAY, MAY 5, 1894. FORTNIGHTLY ONE PENNY.


## CONTENTS



## EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in No. 2, Volume II.*

MENSURATION.—(CONTD.)

PROB. IX.—To find the area of an irregular polygon.

(1) Divide the figure into triangles (or trapezoids and triangles) and find the area of each separately Prob. VIII, (or Probs. VI. and VIII.) Add these areas together and the sum will be the area of the polygon.

(2) Or by equalising (Prob. VIII, No. 5, Vol. II). Construct a triangle equal in area to the figure, and find the area of the triangle. This will be the area of the polygon.

Example.—What is the area of the irregular polygon ABCDEFG (Fig. 52) by rule 1, the following lines being given?

| | | |
|---|---|---|
| $Aa = 9$ | $GC = 28{\cdot}4$ | $FD = 35$ |
| $GB = 29$ | $Ff = 14{\cdot}5$ | $Ee = 7{\cdot}4$ |
| $Cc = 11$ | $Cb = 13$ | |

$Aa = 9$
$Cc = 11$

2 | 20 sum
10 half
29 diagonal GB
290 = area of ABCG.

$Cb = 13$
$Ee = 7{\cdot}4$

2 | 20·4 sum
10·2 half
35 diagonal FD
357·0 area of FCDE

$Ff = 14{\cdot}5$
$\frac{1}{2}$ GC = 14·2
205·9 area of GFC

290 = area of ABCG
357 = area of FCDE
205·9 = area of GFC

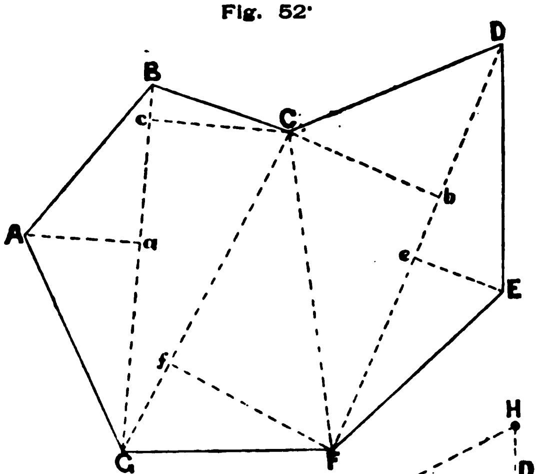
Answer.—852·9 = area of ABCDEFG.

The above method of ascertaining the area of the figure is never adopted by the surveyor as it would necessitate a large amount of unnecessary work, especially in the case of a many-sided figure. By rule 2 the area of the figure can be found almost before it is divided into triangles by the first case. The method of constructing the triangle has been shown before in a formal manner (Prob. VII, No. 5, Vol. II); but as it is somewhat difficult for the beginner, the proper routine will be here given.

Let ABCDEFG (Fig. 53) be the polygon whose area it is required to find. Any side produced of the figure may be taken as the base of the triangle, which is to be made equal in area to the polygon. Let us take DE as the base and produce it both ways. Then take a pricker in the right hand and

place the left hand on the top of the paralle ruler at the centre, so as to be able to move it in any required direction. Now place the pricker at the point D, and move the ruler uutil its edge is in a line with D and the

Fig. 52·



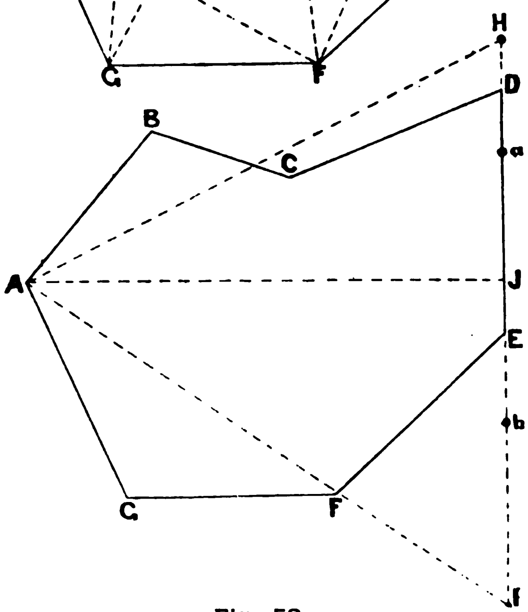




Fig. 53.

second bend of the figure, viz.: B. This is done quickly and correctly by first placing the right-hand side of the ruler against the pricker, and then moving the left-hand side until its edge is at the point B. The ruler being held in position by the pricker at one side renders it necessary to look only at the other, and thus much time is saved. The edge of the ruler being in the line BD, draw it gently down until its edge reaches the point C—the first bend from the point of commencement. Next remove the pricker from the point D and insert again at that point in the line HI where the ruler, when drawn to C, crosses. This will be found to be at *a*. In other words, a straight line joining B and D would be parallel to a straight line joining C and *a*. Next place the ruler in a line with A (*i.e.*, the third bend) and *a*, and, removing the pricker, push the ruler back until its edge is at the point B. The ruler now crosses the line HI at H, where a mark is made with the pricker, and a line is drawn from A to H. The five-sided figure AHEFG is then equal to the seven-sided figure ABCDEFG. It now remains to construct a triangle equal to this five-sided figure. Commence again by inserting the pricker at the point C, and place the ruler in a line with this point and the second bend G. Then draw the parallel rule down to the first bend F, and the point where it will cross the base line will be *b*. Again insert the pricker at *b*, and place the ruler in the line A*b*, and parallel back to G. The crossing of the ruler on the base line will then be I, and a line is drawn joining AI. AHI is then the triangle required. The course adopted to construct this is simply as follows:—Take the point where the proposed base line touches the figure, Take the ruler to the second bend and parallel back to the first. Next to the third and back to the second, and so on, no matter how many sides the figure may have. Although the description of the formation of the triangle has taken some time, and may appear intricate, yet after a little practice the reader will be able to construct a triangle from which to ascertain the area of a many-sided figure *in a few seconds*. Let the reader construct an irregular figure for himself, and try to follow the routine given. He might afterwards test the accuracy of his work by dividing the figure into triangles, as by rule 1, and ascertain its area in that manner. Now it is still required to find the area of the triangle AHI. Drop a perpendicular (AJ) from the angle A to the base, and with the scale measure HI and AJ. HI is found to measure 45, and AJ 37·9

By prob IV (No. 5, Vol. II):—

$$\frac{\text{base} \times \text{perpendicular}}{2} = \text{area.} \quad \frac{45 \times 37{\cdot}9}{2} =$$

$$\frac{1705{\cdot}5}{2} = \underline{\underline{852{\cdot}75}}\text{.—Answer.}$$

(*To be continued.*)

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Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

(*Continued from No. 11, Vol. II.*)

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

### Subject.— GASES AND VENTILATION.

QUESTION 1.—Enumerate the noxious gases found in collieries, and state the composition of each.

ANSWER.—The following gases are found in collieries:—

*Carbonic Acid* or *Carbon Dioxide*, called by miners "stythe" or "black-damp." Carbonic acid is a compound of one volume of carbon with two volumes of oxygen. Symbol, $C O^2$. Specific gravity, 1·529.

*Light Carburetted Hydrogen* or *Marsh Gas* or *Methylic Hydride*.—This gas is composed of one volume of carbon with four volumes of hydrogen. Symbol, $C H^4$. Specific gravity, ·5592.

*Heavy Carburetted Hydrogen, Olefiant Gas* or *Ethylene*.—This gas is composed of two volumes of carbon with four volumes. of hydrogen. Symbol, $C^2H^4$. Specific gravity, ·9784.

*Carbonic Oxide* or *Carbon Monoxide*.—This gas is composed of one volume of carbon with one volume of oxygen. Symbol, C O. Specific gravity, ·9678.

*Sulphuretted Hydrogen* or *Hydrogen Sulphide*.—This gas is sometimes found in coal mines. It is composed of two volumes of hydrogen with one volume of sulphur. Specific gravity, 1·1748. Symbol, $H^2S$.

QUESTION 2.—In what ways may danger arise from coal dust in collieries? Describe the means now employed for counteracting the danger.

ANSWER.—Danger may arise from coal dust when it accumulates in the vicinity of shot-firing, and, in this case, should a blown-out shot occur, even in the absence of fire-damp, an explosion is quite possible to be the result, or at any rate this flame (by the agency of highly-combustible coal dust) may become so propagated through a large area of the mine, and may be communicated to other parts of the mine where an explosive mixture exists, or even if slightly inflammable gas be present, in addition to coal dust, the disastrous effects by this means communicates to other parts of the mine. Or, should an explosion of fire-damp happen where this highly inflammable coal dust exists, the effect of the explosion would be considerably aggravated and enlarged by it. There is no doubt but that many of the large explosions that have occurred have been considerably enlarged and the effects far more disastrous, both to life and property, through the agency of coal dust than would otherwise have been the case in the absence of coal dust.

To counteract this danger a systematic watering of the mine, by various methods, have been adopted. In cases where watering would injure the roof or floor the explosives used must be with water or other contrivance so as to prevent it from inflaming gas or coal dust, or is of such a nature that it cannot inflame gas or dust.

QUESTION 3.—Describe fully the provisions of the Coal Mines Regulation Act of 1887, with regard to ventilation, inspection, and working with locked safety lamps.

ANSWER.—The C.M.R.A. requires that an adequate amount of ventilation shall be constantly produced in every mine to dilute and render harmless noxious gases to such an extent that the working places, levels, stables and workings of the mine; also the travelling roads to and from the working places, shall be in a fit state for working and passing therein. If a furnace is used for ventilating a mine newly opened after the passing of this Act, the return air, unless it be so diluted as not to be inflammable, shall be carried off clear of the fire by means of a dumb drift

The quantity of air in each split or current shall be measured, and recorded in a book kept for the purpose, at least once in each month, when the mine is under a certificated manager under the Act.—(General Rule 4.)

Inspection of a mine before commencing work should be made by a competent person or persons appointed by the owner, agent, or manager for the purpose, not being contractors for getting mineral in the mine, shall, within such time immediately before the commencement of each shift as shall be fixed by special rules made under the Act, inspect every part of the mine situate beyond the station or each of the stations in which workmen have to work or pass during that shift, and shall ascertain the condition thereof so far as the presence of gas, ventilation, roof and sides, and the general

safety are concerned. Inspection must be made with a locked safety lamp, except in the case of any mine in which inflammable gas has not been found within the preceding twelve months.

QUESTION 4.—What are the conditions and precautions under which shot-firing may be permitted in a fiery mine?

ANSWER.—The C.M.R.A says that a shot shall not be fired in the same ventilating district in which inflammable gas has been recorded, according to general rule 4, in either of the four previous inspections made (1) unless a competent person appointed by the manager has examined the place where the gas has been reported to be present, and has found that such gas has been cleared away, and that there is not sufficient gas issuing or accumulated to render it unsafe to fire the shot; or (2) unless the explosive employed in firing the shot is so used with water or other contrivance as to prevent it from inflaming gas, or is of such a nature that it cannot inflame gas.

The precautions I would use in shot-firing in a fiery mine would be to have all shots fired whilst the ordinary workmen are out of the mine, and only allow those men who are actually engaged in firing shots or inspecting the mine, and those that may be required for attending to ventilating furnaces, engines, steam boilers, machinery, or other apparatus which would be actually required, not exceeding ten in number. Use only one of the explosives such as roburite which do not give off flame, and all shots to be fired by electric battery.

*(To be continued.)*

## CORRECTION.

In my answer given to Question 4 of No. 10, Vol. II, my attention has been drawn to an error, which I wish to correct.—J. CARTER.

Diagonal $= \sqrt{45^2 + 28^2} = 53 = AC.$

$$\frac{45 + 28 + 53}{2} = 63.$$

$63 - 45 = 18$
$63 - 28 = 35$
$63 - 53 = 10$

$\sqrt{(63 \times 18 \times 35 \times 10)} = 630$ area of ABC.

Triangle ACD:—

$$\frac{53 + 60 + 57}{2} = 85.$$

$85 - 53 = 32$
$85 - 57 = 28$
$85 - 60 = 25$

$\sqrt{(85 \times 32 \times 28 \times 25)} = 1379{\cdot}85$ area of ACD.

$1379{\cdot}85 + 630 = 2009{\cdot}85$.—*Answer.*

## COMPETITION QUESTIONS.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

1.—All envelopes must be marked "COMPETITION."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by May 12th, 1894.

### ELEMENTARY.

*Question* 1.—State the qualities and dimensions of the varieties of timber most suitable for use in mines.

*Question* 2.—Describe the preparatory operations in the commencement of the sinking of a shaft.

*Question* 3.—Show, with sketch, how the proving of a coalfield by means of a few boreholes may be delusive.

### ADVANCED.

*Question* 4.—Of what is dynamite made, and how is it used?

*Question* 5.—Describe, with sketches, a double-deck cage, and describe clearly the method of attaching wire rope guides.

*Question* 6.—Give a description of the Forest of Dean coalfield.

### FIRST-CLASS

*Question* 7.—How do you arrive at the proper angle supporting timber should be fixed in mines of steep inclination? Give illustrative sketches.

*Question* 8.—Under what circumstances would you adopt the longwall method of working?

*Question* 9.—What is the advantage of noticing the changes of the barometer at a colliery.?

*Question* 10.—Give sketch and description of the ordinary bricking scaffold used in sinking pits.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

## RECENT IMPROVEMENTS
IN
# MINING MACHINERY & APPLIANCES
BY
MR. WM. SAINT, H.M.I.M.

(Address read before the Manchester Geological Society.)

AS the comparatively shallow mines become exhausted other have to be won at greater depths to take their place and keep pace with the increasing demand for a supply of coal. To meet the requirements in some instances, the shafts of existing mines have been enlarged and sunk deeper, and the mechanical arrangements, in a great measure, have been remodelled. In other cases it has been necessary to take entire new winnings, involving a large expenditure of capital. Next in importance to the possession of a valuable coalfield, of ample extent, is the application of the most suitable machinery in its development. I will therefore endeavour to review the principal improvements that have been effected in mining machinery and appliances within recent years.

### BORING.

Where a moderate depth of boring is required, and an accurate section and expedition are not essential, the application of the ordinary rods and rocking lever worked by hand is perhaps the cheapest method, but where great depths have to be penetrated it is usual to adopt some special method of boring, such as *Mather and Platt's* system, in which a flat hemp rope is employed to suspend the boring head. The rope is carried on a drum worked by a steam engine; it is passed over a pulley running in bearings fixed on the end of a vertical piston rod which works in a steam cylinder; the rope is clamped between the drum and the pulley, and the necessary percussive action is obtained by admitting steam to the lower side of the piston, which then raises the cutting tool and returns to its original position on the steam being exhausted. The valve motion is worked by tappets actuated by the piston rod; the tuppets can be altered and the length of the stroke varied accordingly. The rotary motion of the tool is effected by means of an ingenious arrangement of three collars fitted thereon, and having horizontal ratchet teeth. The upper and lower collars are fixed and the centre one loose; the latter slides on the tool bar at each stroke, and its teeth alternately engage those of the other collars in such a manner as to insure the definite rotation of the boring head.

In the American system a rope is also used and many improvements have been introduced to effect rapid boring in moderately hard ground; it has been largely used in the United States of America for prospecting purposes, and latterly it has been introduced into England, and applied with great success in boring for rock salt in Middlesborough, and also in the neighbourhood of Fleetwood for a similar purpose.

The most scientific method of boring however is that of the diamond drill; the diamonds are imbedded on the inner and outer edges at the end of an iron crown, which is grooved on the outside and fitted to the main boring piece; this in its turn is secured to the hollow rods connected by bevel gearing to the steam engine, which gives them the necessary rotary motion. A stream of water is forced down the centre of the rods to the bottom of the hole, and washes out the *debris* up through the grooves of the outer side of the crown piece and so on to the surface. A cylindrical core, corresponding in diameter with the internal size of the crown is formed, and may be broken off and secured by a split ring fitted in the core tube and raised to the surface by withdrawing the rods. One improvement is the application to the upper end of the rods, of a clamp and hydraulic cylinder and hollow piston rod (through which the rods pass) to regulate the feed; it also enables the weight on the diamond crown to be adjusted, and thereby prevents the breakage of diamonds which formerly occurred. Another improvement consists in the use of separate appliances for rotating, raising or lowering the rods in the bore hole, and for pumping, instead of the old combined arrangement; these tend to save time in manipulation and reduce the liability to accident to a minimum. There are also better methods for preserving the cores intact. Effective means are adopted for protecting cores of coal or soft strata from the disintegrating action of the feed water and the vibration of the bore rods, so that it is now possible to obtain cores of coal seams which would have been ground to powder and raised in the water with the older machines.

*(To be continued.)*

## ANSWERS TO QUESTIONS

**In No. 10, Vol. 2.**

### ELEMENTARY.

*Question* 1.—What are safety lamps, and state what limits are they to be considered safe?

*Answer.*—Safety lamps may be defined as lamps that will give light sufficient for the requirements of miners in travelling and working, and will not ignite an explosive mixture in which they may be placed. The two essential merits required in a lamp are:—First, safety; second, good light. A very large number of lamps have been introduced since the invention of the original safety lamps, each claiming superiority over others, but none of them have been found to be perfectly safe and secure under all circumstances when exposed to explosive mixtures. It has been proved that lamps which are considered safe in a slow current become unsafe when the current travels or they travel against the current, above a certain speed. Mines, nowadays, are much more extensively opened out than in former years, and, in consequence, the ventilating currents are greater, and move at higher velocities. The *Davy*, *Clanny*, *Stephenson*, and many other lamps which were formerly considered safe are, on this account, deemed unsafe in modern mines. Their construction must be such as to enable them to safely withstand the velocity of the air travelling in the mine.

The velocities of currents at which the following lamps become unsafe, according to accepted measurements, are:—

| | | | |
|---|---|---|---|
| *Davy* ... ... ... | 6 | feet | per second |
| *Clanhy* ... ... ... | 8 | ,, | ,, |
| *Stenpenson* ... ... | 13 | ,, | ,, |
| *Meuseler* ... ... ... | 21 | ,, | ,, |
| *Bonnetted Meuseler* ... | 40 | ,, | ,, |
| *Marsaut* ... ... ... | 40 | ,, | ,, |
| *Tin-Can Davy* ... ... | 40 | ,, | ,, |

RICHARD RENTON,
Riding Street, White Lea,
Batley, Yorkshire.

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*Question* 2.—A pit 14 feet long, $5\frac{1}{2}$ feet wide, and 80 fathoms deep. Find weight of debris raised, if 130 pounds equals one cubic foot.

*Answer.*—In the first place, we will proceed to find the cubical contents of the pit by multiplying the width, breadth, and depth together in feet.

$$14 \times 5\tfrac{1}{2} \times 80 \times 6 = 36960 \text{ cubic feet.}$$

Now, as the weight of the debris raised is 130 pounds to the cubic foot, if we multiply the cubical contents of the pit by the weight of a cubic foot of debris, we get the total amount.

$$36960 \times 130 = 4804800 \text{ lbs.}$$

If we now divide 4804800 by 2240 we get the number of tons.

$$4804800 \div 2240 = \underline{2145 \text{ tons.}}$$

ALBERT HY. MEAKIN,
Mansfield Road,
Eastwood, Notts.

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*Question* 3.—What are the regulations as to the opening of safety lamps in fiery mines?

*Answer.*—A competent person appointed by the manager or under-manager for the purpose, shall, either at the surface or at the appointed lamp station, examine every safety lamp immediately before it is taken into the workings for use, and see that it is in good working order and securely locked. A safety lamp shall not be unlocked except either at the appointed lamp station or for the purpose of firing a shot, and no person, unless he has been appointed either for the purpose of examining safety lamps or for the purpose of firing a shot, shall have in his possession any contrivance for opening the lock of any safety lamp. Where safety lamps are required to be used the position of the lamp stations for lighting or re-lighting the lamps shall not be in the return air. Should any person in charge of a safety lamp loose his light, he shall take it himself to the station. All safety lamp keys authorised to be used shall be officially stamped and numbered, and no official or workman, under any pretence whatever, shall have in his possession a key or any contrivance for opening a safety lamp, unless holding a written authorisation from the manager or under-manager of the mine in which he is employed.

F. KING,
Cramlington Colliery,
Northumberland.

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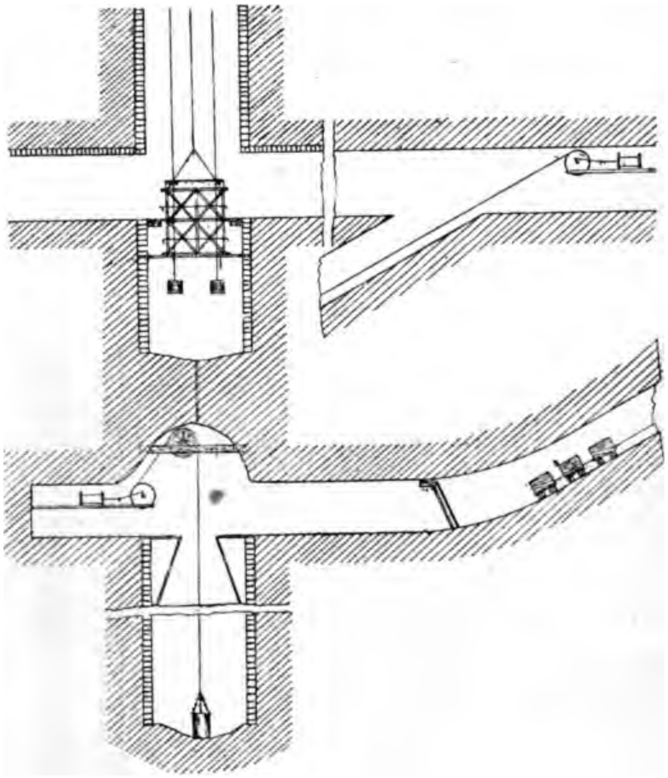
### ADVANCED.

*Question* 4.—How is the sinking of a shaft conducted when the upper part is in use for drawing materials?



*Answer.*—The enclosed sketch illustrates the method I prefer, and which has been practised with considerable success. At a certain point a distance away from the bottom of the shaft to be deepened, a tunnel is commenced, and is driven at such an angle as to come directly under the bottom of the shaft at a distance of about twelve yards below the sump hole, thus leaving a stratum of solid material of twelve yards in thickness between the bottom of the shaft and the bottom of the tunnel. From this point the sinking is proceeded with in the ordinary manner. A frame is fixed under the centre of the sump hole and a pulley inserted, over which the rope passes which is to draw the sinking debris. An engine is placed at the left of the new shaft with which the sinking operations are conducted. The debris on reaching the top of the shaft is emptied into the tubs at the bottom of the tunnel, and drawn up the tunnel by an engine, placed at the top, to the level of the "hooking-on," and thence taken to the pit bottom and sent up. The ordinary winding of coals is thus not interfered with during the deepening of the shaft. The solid strata left in would be taken out when the sinking had reached the requisite depth. *Galloway's* patent bricking scaffold should be used in all sinking pits. Very strong safety appliances should be adopted to prevent the tubs from running down the incline and into the sinking pit. A borehole is generally put down from the centre of the winding shaft to ensure the new sinking lying in its correct position.

WILL. LITTLER,
234, Woodhouse Lane,
Wigan.

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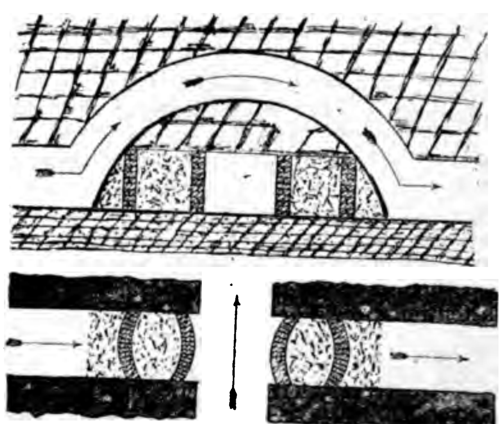
*Question* 5.—Describe the contrivances necessary for splitting and coursing air currents underground. Give sketches of same.



*Answer.*—The contrivances necessary for splitting and coursing air currents are as follows:—(1) An overcast or air crossing is used to carry the return air current over the intake, or *vice versa.* (2) Regulators are used in the return splits of those districts which have the least resistance, in order that the farther districts may have their share of the ventilation. (3) Doors are required to separate intake and return airways where corves have to pass through. There should always be two, one to be shut whilst the other is opened. (4) Stoppings are used to direct the air in its proper course. (5) Brattice cloth, and sometimes deal packings, are used to make an intake and return in places, when cutting in fast. (6) Air pipes made of sheet-iron or timber are used for ventilating purposes.

JOHN COOK,
28, Smithy Green Smithies,
Barnsley.

*Plan and section of air crossing.* *(Sketches of Door and Regulator appeared in Nos. 3 & 5, Vol. II.)*

*Question* 6.—What interruptions are likely to be met with in working coal seams?

*Answer*.—The interruptions to be met with are—(1) FAULTS: They are frequently met with in the working of coal seams, and are well known to all miners. A fault may be defined as a crack or fissure in the strata, more or less vertical, accompanied with a vertical displacement of the beds either upwards or downwards from their original position. (2) DYKES.—These dykes when met with in coal mines rank next in importance to faults. A dyke is a fissure in the earth's crust filled with igneous rock which has been forced upwards in a molten condition, and has since cooled and hardened, some throw the beds up, or in other words acts like a fault, and others do not. (3) BALKS are another kind of interruption in coal seams. They are sudden depressions of the roof of the coal seam, whereby the latter is considerably reduced in thickness. They often occur with a sandstone and sometimes with a shale roof. (4) ROLLS are the reverse of balks. The thill or floor of the seam suddenly rises until it may cut through the coal and meet the roof. They occur in nearly all coal mines, and are probably due to the undulations of the old land surface upon which the coal was deposited, and which now forms the thill of the coal seams. (5) NIP-OUTS.—These occur when the roof and thill approach each other, and diminish the usual thickness of the coal seam or nip it out completely. They are not so frequent as balks and rolls. (6) SWELLIES.—These are thickenings of the coal seam for a short distance, and vary much in dimensions. (7) WASH-OUTS.—Sometimes a seam will terminate abruptly by coming against sand and gravel which has the appearance of once having been the bed of an ancient river. Other interruptions occur, such as the splitting of seams into two or more portions making it unworkable, owing to the bands of stone which divide it into thin layers of coal too thin to be worked.

HENRY TALBOT,
Ince Green Lane, near Wigan.

## FIRST-CLASS.

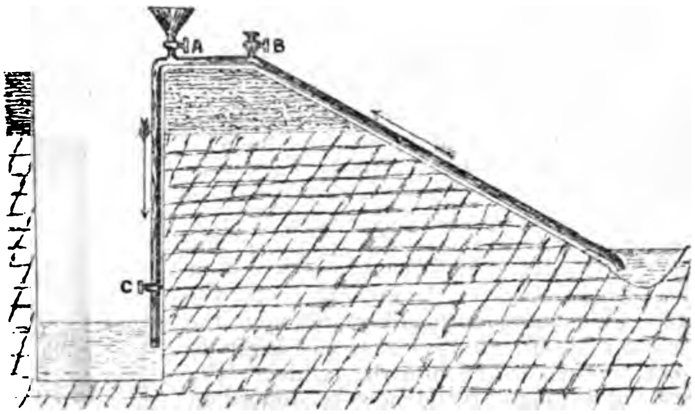
*Question* 7.—Describe the construction of a pumping engine driven by the pressure of a column of water.

*Answer*.—An engine of this description is constructed of a length of tubes led from the feeder of water to be taken advantage of to the place where it is about to be applied as a motive power. At the end of the tubes a double pipe is fitted on to give the pressure alternately to each side of the motor cylinder, and a slide valve placed at the bottom of this double pipe to direct the water to the side of the cylinder required. This valve is worked in conjunction with the motor cylinder piston by being secured to a tappet fixed on this piston. Below the slide valve is a cylinder valve which consists of a small cylinder with a block of iron working on it. Below this are two pipes leading to each side of the motor cylinder. The block of iron in the small cylinder is made so that it always covers one of the ends of these two pipes. Below the two pipes is the motor or pressure cylinder, which piston terminates in the ram or plunger of a double or single acting force pump. The *modus operandi* of working an engine of this description is as follows:—The water is allowed to fill the tubes. It comes down both ends of the double pipe at the end, but is only allowed to pass through one port of the side valve to the cylinder valve, where it comes in contact with the iron block. It forces the iron block along over the end of the other pipe, thus allowing no water to pass to the other end of the motor cylinder. Having removed the block it passes to one end of the piston and gives it its necessary stroke. Now, when this stroke is being made, the tappet on the piston of the cylinder is opening the slide valve and allowing the water to pass down the other pipe to make the other stroke of the engine. The water is exhausted, at every stroke, into the rising main of the pump.

Such engines should have their situation at the lowest extremity of the colliery, and where two seams are being worked, the engine can be situated in the lower seam, and made to force its water into the standage of a steam pump situated in the upper seam. The reason of the pressure pump being so situated is obvious, for if an extra flow of water were to be coped with, in the event of the engine being drowned out, it would continue to work and force its water into the standage above, whereas, if the steam pump were so situated, it would be rendered practically useless. No lubricant is needed for these engines, the water acting as a lubricant. They only requre the parts being well filled with soft soap to render them properly air-tight They require no attention, working strictly automatically.

GEO. A. HAWES,
Holy Trinity Terrace,
East Murton, Durham.

*Question* 8.—Describe the general arrangement (with sketch) for working a syphon.




*Answer.*—The annexed sketch shows the principle on which a syphon acts. The intake end of the pipe is seen on the right-hand side of the figure. The pipe ascends to the top of a slight elevation, and then descends below the level of the surface of the intake water. The intake end of the pipe is fitted with a self-acting valve which will only open to admit water, and the delivery end is provided with a tap (C) which is shut during the process of filling the pipes with a solid column of water. The funnel (A) is used for filling the pipes with water, and the cock (B) allows the air to escape during the process of filling the pipes. When the water overflows at B, the taps (A and B) are shut and the tap at the delivery end of the pipe is opened, when the water flows from the standage at the right-hand side of the figure through the pipes and out at the delivery end. Now, it is well known that water will ascend a complete vacuum 34 feet, but, in order to obtain a flow allow a little pressure to overcome friction and the lifting of the valve at the intake end, the altitude, in practice, should never exceed twenty feet, and not even this if the lead be considerable. Th delivery leg of a syphon should never have less nor more than 34 feet of vertical fall, and, if the altitude be subtracted from 34, we have the motive column or pressure producing the flow of water and overcoming friction. If the delivery pipe has a greater fall than 34 feet the column of water in the pipe breaks, and air gurgles up the pipes and stops the action of the syphon. The delivery end of the pipes are turned slightly upwards or inserted in water to prevent air gurgling up the pipes.

WILLIAM ROBSON,
Prince Row, Tow Law, R.S.O.,
Co. Durham.

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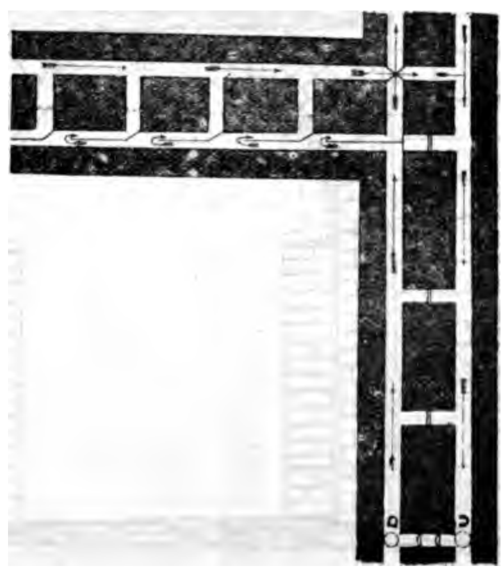
*Question* 9.—If a mine 5 feet high (having two brows 500 yards each in length, cut through every 30 yards, the pillar between brows being 30 yards wide) were filled with an explosive mixture, show by sketch, and explain fully what method you would adopt to clear them.

*Answer.*—Supposing the brows to be situated as shewn in sketch, that is, the first brow commencing from a main level (the intake), and the second brow commencing from the main return level, and crossing the in-take by means of an air crossing, as shown in sketch, I should proceed as follows:—

(1) ***All ordinary workmen must be out of the pit,*** because, by the Act, no serious accumulation of gas must be removed, except when the ordinary workmen are out of the pit.

(2) To begin to remove the gas, I would take a cloth (shewn in sketch) from lower side of main in-take level and carry it up (thus clearing the first thirty yards as we proceed gradually with the brattice) to the first cut through. I would then place a fast cloth across the main in-take, just past the bottom of the first brow. The air would then course



**REFERENCES:**

D—Down-cast U—Up-cast
X—Air Crossing I I—Stoppings
DD—Doors I—Brattice
: : —Brattice to be put in after the brow is cleared to the next cut-through
Direction of current shown by arrows

through the first cut through, down the back or second brow, over the air crossing, and into the return. I would next remove the brattice from the first thirty yards of the brow, as it would now be unnecessary, and carry it up-brow—from the lower-side corner of the cut throw to the second cut throw—and clear this second length of the brow as we did the first. Having reached and cleared up to the second cut through the air would begin to work through it and into the return. The first cut through should now be stopped off by means of a fast cloth, the cloth in the brow removed another length further up the brow, and the same process carried on until all was cleared.

WILLIAM ATHERTON,
236, Woodhouse Lane,
Wigan.

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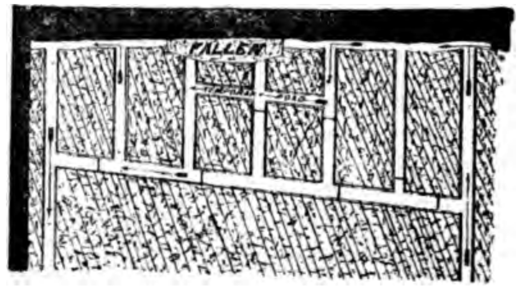
*Question* 10.—Show, by a sketch, how you would direct the air current in six places (working widework) when two of them are fallen up at the face. Mark the cross roads and drawing roads.

*Answer.*—The accompanying sketch shews the arrangement of working places, two of which are fallen up. The ventilating current passes up the jig-road on the right, and originally along the full length of the face and




down the return airway on the left. But this it cannot now do by reason of the fall. A temporary road must therefore be made across the packs, and the air be driven through it by arranging the canvas doors as shewn. The manner by which it is effected will be easily understood by referring to the sketch.

WM. ROBSON,
Prince Row,
Tow Law,
Co. Durham.

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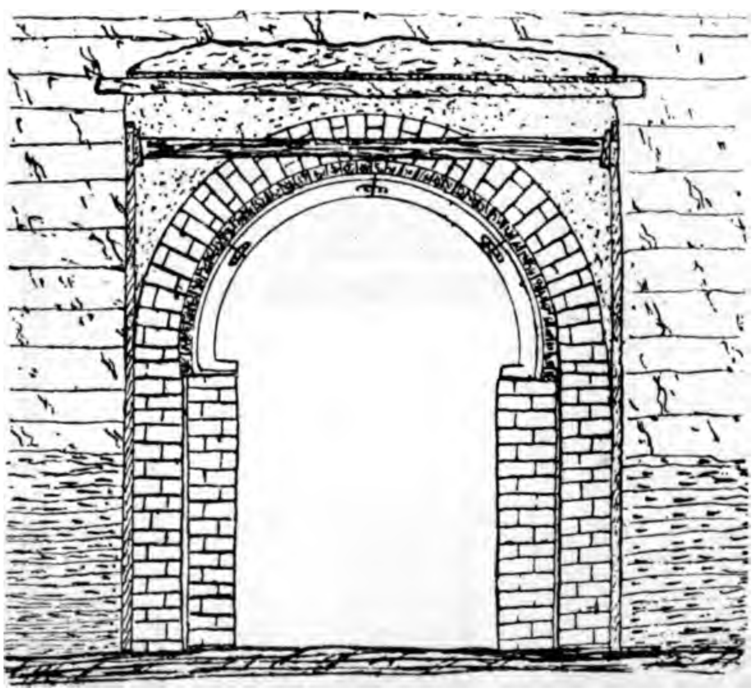


The accompanying sketch illustrates the following question the answer to which appeared in No. 10, Vol. II.:—

Describe and illustrate by any sketches you may deem necessary, how you would support an excavation preparatory to building a rather large arch, and state how you would proceed with the brick-work. Describe also the manner in which the excavation is cut or driven.

# CORRESPONDENCE.

**We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—**

**To be written on one side of the paper only.**
**Envelopes to be marked "Correspondence."**
**Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.**

**The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.**

### OUR COMPETITION QUESTIONS.

Sir,—I notice in looking through my Vol I. of your valuable paper the names of students whom I know must be in the Advanced and Honours figuring in the successful questions of the Elementary Stage. I might say it is not my intention to be in any wise personal in these remarks, but a glance through Vol. I. will enable readers to see who the offending parties are. I do not insinuate that that they are in any way debarred from competing in such manner, as your rules in regard to the competition justify them in so doing. Now I think that the intention of "Competition Questions" is to give the award to the sender of the best answer, no matter in what stage he has really passed, if Honours' students choose to compete for Elementary Questions he is quite at liberty to do so; is this right? I unhesitatingly answer, no. Why should he compete with the student of perhaps a year's standing, whose humble efforts are really good considering the time he has studied; but his humble effort is not appreciated, an Advanced student has taken the question of perhaps six years study; the beginner is thus "plucked" and disheartened and tries no more. Is this a fair footing for an Elementary student? All will agree with one accord that it cannot be so. Now I think that the intention of the insertion of these "Competition Questions" should be to give the prize to the best Elementary student for the best Elementary question answered; allow him to compete in the higher stages; let the Advanced student answer in his stage and the higher ones, but by no means let him come back to the Elementary stage. For these students to aspire to the higher branches of the tree is a honour, but for Higher Grade students to come from the topmost branches to grovel among the roots, hindering their growth is a despicable action and worthy of condemnation. Now you will no doubt see what I am driving at, Mr. Editor, and it cannot do otherwise than receive your consideration. I know other organs of mining carry on their competitions in a similar way, but it is not to say that because others are wrong, "Mining" should tread in their paths—two wrongs can never make a right—therefore I beg leave to introduce my idea of fairness to the readers of "Mining," hoping they will give their opinions of the same.

*Elementary Questions* to be answered solely by Elementary students. Elementary student can answer in any stage.

*Advanced Students* can compete in Advanced and First-class stages, but by no means to recede to the Elementary stage.

*First-class Students* to answer in the First-class stage alone.

By this means each student will gain the prize on his respective merits. The best Elementary answer will go to the best Elementary student, whilst the other stages will be the same.

GEO. A. HAWES.

Thanking you in anticipation, Mr. Editor, sincerely hoping you will find space for insertion, and also correspondence on above. I have been brought to write this from complaints from students, and I think the above plan, if suitable to you, will remedy it.

G. A. H.

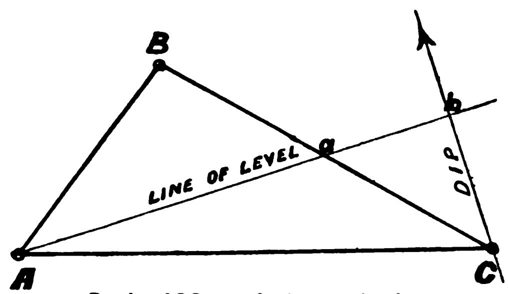
### RE OUR COMPETITION QUESTION.

**(We quite agree with our correspondent that Advanced students should not answer the Elementary Questions, but fail to see how he proposes to remedy it. How are we to know whether a student is an Advanced one or not? There must however be some means of overcoming this difficulty, and we await the decision of the combined intellect of our many clever readers.—EDITOR.)**

### INCLINATION OF SEAMS FROM BOREHOLES.

Sir,—In No. 10, Vol. II., of your journal, "A Constant Reader" gives the following question:—

Three pits, A B C, are 80, 100, and 60 yards deep. From A to B is 500 yards, A to C 1,000 yards, and B to C 800 yards, find area enclosed and inclination, also level course of seam. To which I append my solution:—




**Scale 400 yards to an inch.**

The above plan of the boreholes will illustrate more clearly how my solution is arrived at. A is 80 yards and B 100 yards deep, therefore A is 20 yards above B. Again C is 60 yards, therefore C is 40 yards above B. That is the seam rises 40 yards in 800 yards in the direction of the line B C, therefore it will rise 20 yards in 400 in the same direction. On the line B C measure off a part B*a* = 400 yards. Then the seam at both the points A and *a* is 80 yards deep, therefore a line joining these points must be the level direction of the seam. From C drop a perpendicular C*b* to A*a* produced. C*b* is the dip of the seam. Now to find the rate of dip measure C*b* which will be found to be about 290 yards. The level line A*ab* is 80 yards deep and C is 60 yards deep, therefore the greatest dip is 20 yards in 290 or 1 in 14½. To find area of triangle A B C:—

$$\frac{500 + 1000 + 800}{2} = 1150$$

$$1150 - 500 = 650$$
$$1150 - 1000 = 150$$
$$1150 - 800 = 350$$

$$\sqrt{1150 \times 650 \times 150 \times 350} = \underline{198098 \text{ sq. yards.}}$$

SURVEYOR.

**(A full and clear account of how to find the inclination of seams from boreholes is given in No. 15, Vol. I.—EDITOR.)**

### Mine Gases.

Sir,—If your correspondent, Mr. T. Burford, follows Mr. Atkinson very closely, he will find that he gives the following proportion, 1 of fire-damp to 9·4 of air the most explosive mixture, all other proportions forming less explosive mixtures, and not 8 or 9 of air to 1 of gas, as Mr. Burford gives when trying to correct Mr. Davies's answer to the question on fire-damp. Trusting you will correct him before he gains too much ground. T.G., L.T.

### The Issue of Gas near Faults.

I would be pleased if you would insert the following question in your correspondence page to be answered by some of your readers:—"Sometimes less gas is given off on approaching a fault than otherwise. What is the reason of this?" I am aware that in the majority of cases more gas is given off from the listing of the fault, but in some cases the circumstances quoted above occur. An explanation will oblige. Miner.

### H. P. of Engines.

Sir,—In answer to J. Moore's question I offer the following:—D2 × ·7854 × 200 × 7 ÷ 33000 = H. P. 552 = 3025 × ·7854 × 200 × 7 = 3326169 ÷ 33000 gives 100·7 H. P. T.G., L.T.

(Correct answer also sent by A. Street, Engineer, and J. Hartley.)

### Sinking through Quicksand.

Sir,—In answer to the question put by "Sinker" in No. 8. Vol. II, I offer the following:—

If the quicksand occurred after only a few fathoms had been sunk I think its proximity should have been known from the trial borings, and the sinking should have been commenced so as to allow of the ordinary pile-driving process, as described in No. 20, Vol. I, of your Journal. But, if the quicksand was struck after a considerable depth of strata had been sunk through (which is a very unlikely case as quicksand usually lies at the surface), the method which I would adopt would depend upon the thickness of the quicksand. If it was, say, four yards thick, I would have a cylinder of long piles constructed, slightly less in external diameter than the finished size of the shaft, the cribs which bound the piles together being placed on the inside. I would force this cylinder through the quicksand by means of heavy weights, and would afterwards brick up on the inside cribs of the piles. A somewhat similar method would be to sink iron cylinders. Both of these methods would have the effect of decreasing the diameter of the shaft about two feet, and, if this could not be allowed, another method would have to be adopted, in which case I would proceed as follows:—Brick the shaft to within three or four yards from the quicksand, and see that the lower crib of the brickwork was well supported on iron bars driven into the hard rock. I would then gradually shear the rock back until the diameter of the excavation at the commencement of the quicksand was three or four feet larger than that of the previous excavation necessary for the brickwork. I would then drive piles all round the excavation with their lower ends slanting away from the shaft, and next remove the quicksand from inside the piles, meanwhile inserting cribs of gradually increasing diameter. When within three feet from the bottom of the piles another series of piles are driven, and the same proceedings carried on. By this method the diameter of the excavation does not decrease, and the walling can be afterwards made of the original diameter. "Well-wisher."

## ANSWERS TO CORRESPONDENTS.

Received:—J. Thompson, Constant Reader, Elementary Student, Fireman, W. Hardman, Thos. Rushton, W. D. Harbit.

J. Burrows (Dalton-in-Furness.)—We are sorry you cannot obtain "Mining" until several days after the date of issue, and cannot understand it. We can do nothing in the matter as the newsagents generally get the paper through our wholesale agents. It is, as you say, rather provoking that you cannot enter for the Question Competition, and it is impossible for us to alter the date upon which the answers must be received unless we miss another issue, and this we have an objection to. The only thing for you to do is to ask your agent to write to his wholesale agent about it, and if this fails to remedy the difficulty, you can obtain the paper direct from our Office.

Commended.—Commencing with next issue we will do as you request, and print a few of the names of those who have sent good answers to the Competition Questions, yet not received the awards.

J.C. (Pontypridd)—Messrs. Strowger & Son inform us that Mr. Carter's "Guide to the Science and Art Exams." will be published about May 14th.

F. Jones (Glam.)—We will consider the possibility of your suggestion.

### Result of Coupon Competition.

The following is the result of this competition:—Award of £1 to J. R. Welford, 245, William Street, Auckland Park, Durham, who sent 288 coupons.

Consolation, award of a Bound Vol. of "Mining" to Wm. Pitt, 65, Coventry Road, Bulwell, Notts, who sent 280 coupons.

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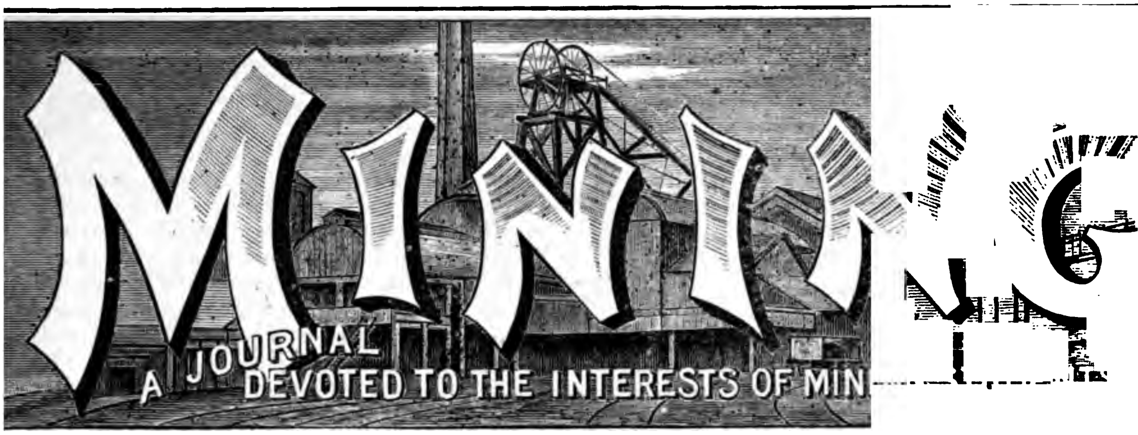



o 13. Vol. II. SATURDAY, MAY 19, 1894. FORTNIGHTLY. ONE PENNY.

## CONTENTS.



# EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in No. 2, Volume II.*

### MEASUREMENTS.

IN order to measure a line it is first necessary to arrive at some determined length which is to be considered as a unit. Thus a foot or a yard may be taken as the unit. The units of a yard, a foot, or an inch are, in the majority of cases, adopted, but in nearly all surveying measurements a special unit known as a link is taken. It was originally used by a Mr. GUNTER, who adopted it to facilitate the working out of areas, and the measure consisting of 100 links is called a chain. A link is 7·92 inches in length, and 100 of these, which go to form a chain, will be 22 yards, or 66 feet, in length. The reason for adopting such a unit will be apparent when it is known that 10 square chains say 1 chain by 10, or 100,000 square links is an acre, and that there are 80 chains in a mile (linear), and 640 acres in a square mile. Now, suppose we had an area given in square links to reduce into acres, all that is required is to move the decimal place five figures to the left, and the result is given in acres and decimals of an acre. For example, to reduce the areas, given in square links, to acres:—

$$\begin{aligned} 7685463 \text{ square links} &= 76{\cdot}85463 \text{ acres} \\ 432681{\cdot}5 \quad ,, \quad &= 4{\cdot}326815 \ ,, \\ 24792 \quad ,, \quad &= {\cdot}24792 \ ,, \end{aligned}$$

The decimals of an acre can be reduced to roods by multiplying by four and cutting off the same number of figures as there were decimals before, which decimals can be reduced to perches by multiplying by 40, and cutting off the decimals. For example:—

$$\begin{array}{r} 76{\cdot}85463 \text{ acres} \\ 4 \\ \hline 3{\cdot}41852 \\ 40 \\ \hline 16{\cdot}92080 = \end{array}$$

76 acres, 3 roods, 16·92080 perches.

There are various methods of measuring lines, viz:—

PACING
THE MEASURING WHEEL
THE TAPE
THE CHAIN
THE STEEL BAND
RODS

PACING consists of simply walking along the line to be measured, and by counting the number of steps taken a rough calculation can be made. After a little practice a fairly accurate measurement can be made in this manner. Thus many persons can measure 100 yards with an error of less than one yard.

The manner in which the MEASURING WHEEL is used is to roll it along the ground, the number of turns which the wheel makes being registered by a series of toothed wheels. On even ground it gives fairly good results.

The TAPE is used by many persons for ascertaining lengths, but, if great care is not taken, it will sometimes give big errors as much as 1 foot in 100. When kept dry and constantly checked it is a very simple and convenient method of measuring. By surveyors it is principally used for taking off-sets or measuring buildings.

STEEL BANDS are much used in the mines of America, and the accuracy of the measurements effected by it are about the same as by a chain. Its greatest disadvantage is its twisting or *kinking* propensity, which often causes great annoyance.

RODS were formerly much in use when accurate measurements were required, but, of recent years, surveyors for the most part have considered well-constructed chains satisfactory. The rods were usually constructed of deal, but on occasions requiring great accuracy glass rods were used. Thus, in 1874, the base line of the Trigonometrical Survey of the United Kingdom was measured with glass rods. The same line was again measured with a

Fig. 54.

carefully-constructed steel chain, and the difference was little more than half-an-inch in a base line of 27,404 feet.

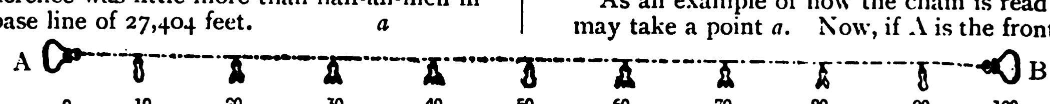
We thus see that a chain of good construction and constantly checked gives an accurate measurement, and, as it is a very convenient method of measuring, is the one adopted by surveyors in this country for general work.

The chain is usually 100 links in length as previously stated, but for surface work a chain consisting of 100 divisions of a foot each is sometimes used. Each division consists of a bar of iron or steel, and the bars are connected together by small coupling links. Thus the length of the bar in a link chain is about six inches, and in a foot chain about ten inches, the remaining length being made up by the coupling links. This allows of the chain being folded up for carrying, as shewn in Fig. 54. The reading of both the link and the foot chain is effected in the same manner, and as it is often a source of difficulty to the beginner we will endeavour to explain how it is done by means of the sketch (Fig. 55). At every ten divisions in the chain a tag or index of brass about 1¼ inches in length is suspended, and as the number of tens from the beginning of the chain is known by the shape of the tag, in order to read off a certain length all that is required is to find the preceding tag and, knowing the number of tags which it represents, add on the odd number of feet or links. But from requiring tags to represent certain numbers on the chain arises a difficulty, viz.:— The same end of the chain must be in front each time, as is the same with a tape, but as it is very convenient to have a chain so that any end may be used as a leader, a sort of compromise was effected with the tags, and instead of having nine different kinds of tags to represent the tens from 10 to 90 we have only five. Thus one tag represents both 10 and 90, another 20 and 80, another 30 and 70, and still another 40 and 60, 50 having a special tag for itself.

The index for 10 and 90 has 1 point or finger
„ „ 20 „ 80 „ 2 „
„ „ 30 „ 70 „ 3 „
„ „ 40 „ 60 „ 4 „ and
„ „ 50 is rounded off.

When measuring it is very easy to tell whether the index is 10 or 90, 20 or 80, or 30 or 70 by noticing the amount of chain run out, but in case of the index for 40 and 60, unless care is taken, a mistake may occur, as there is not much difference between those numbers as the others.

As an example of how the chain is read we may take a point *a*. Now, if A is the front or




leading end of the chain the measurement will be 33, but if B be the leading end it will be 67.

The student will, with this explanation, no doubt understand the arrangement.

(*To be continued.*)

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

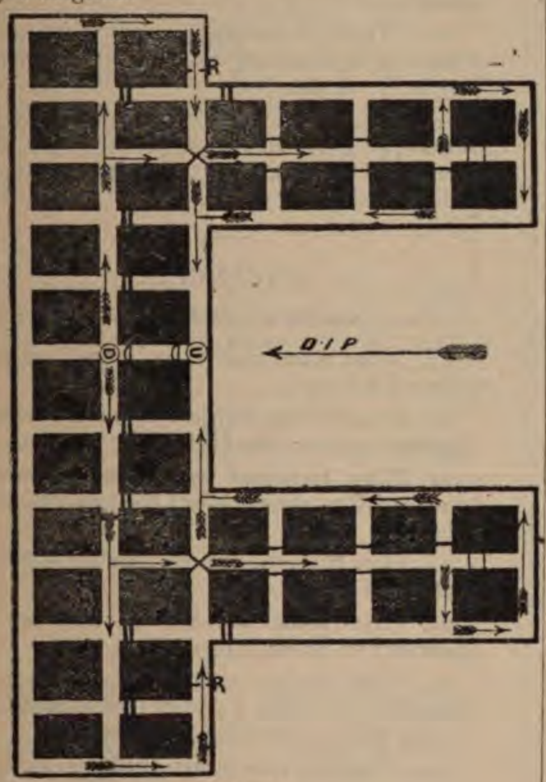
JOSEPH CARTER, First-Class Certificated Manager.

(*Continued from No. 12, Vol. II.*)

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

### Subject.— GASES AND VENTILATION.

QUESTION 5.—Define the term "ventilating district" referred to in the Coal Mines Regulation Act of 1887, and illustrate your answer by a diagram.




REFERENCES:—

D—Downcast U—Up-cast DD—Doors
RR—Regulators XX—Air-crossing II—Stoppings
I—Temporary Stoppings I I—Canvass Doors
The direction of the Air-current is shewn by Arrows.

ANSWER.—"Ventilating district" as meant by the C.M.R.A. means such part of a mine or seam as has an independent intake commencing from a main in-take air course, and an independent return air-way terminating at a main return air-course.—(See sketch.)

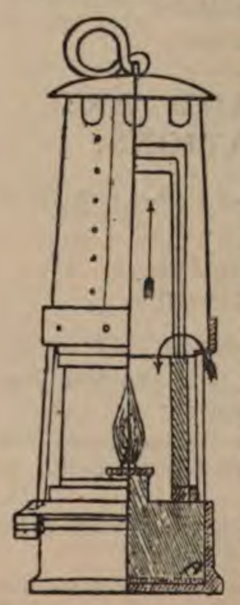
QUESTION 6.—Explain the advantages of splitting the air in ventilating collieries, and state what would guide you in deciding where the main current should be divided and joined to derive the greatest advantage.

ANSWER.—The advantages derived from splitting the air in collieries are:—(1) It enables you to send a greater amount of ventilation through the mine with the same power exerted than would otherwise be if the whole current went round the whole mine. (2) Each district has its own supply of fresh air, so that any gas given off in one of these districts is carried away to the return without having to go into the other workings of the mine, thereby rendering it far healthier for the workmen. Also, any accident that might arise from explosions of gas, blown-out shots, etc., would be lessened by this method.

In splitting the air in mines I should be guided by the fact that to obtain the greatest advantage from doing so would be to commence as near the down-cast shaft as possible and end as near the upcast, because when splits are made too far in the mine from the shaft, we do not get the advantage to the same extent as we should by having splits made and ending as near the shaft as possible.

QUESTION 7.—Give a description, with sketch, of the safety lamp you are best acquainted with.

ANSWER.—The "Marsaut" safety lamp is the one I am most acquainted with. Its construction consists of two, and sometimes three conical cylindrical gauzes fitting one inside the other, and closely fitted together at the bottom on top of the glass cylinder which surrounds the flame. The gauzes are shielded by a sheet-iron cylinder called a bonnet. The air which feeds the flame passes through a number of holes near the bottom of bonnet. The gases given off from combustion escape at the top through a series of holes in the circular shield of the lamp.



This lamp goes out in an explosive mixture. When used with two gauzes it has an illuminating power of about two-

thirds of a candle; with three gauzes the illuminating power is reduced to about one-half of a standard candle. The lamp is much safer with three gauzes than two. This lamp will explode or pass the flame, according to accepted measurements, at 40 feet per second.

QUESTION 8.—The temperature of the air in the down-cast and up-cast shafts of a colliery are 40 degrees Fahr., and 70 degrees Fahr., respectively. What is the volume of air in the up-cast which amounts to the same weight as one cubic foot in the downcast?

ANSWER.—Air expands $\frac{1}{460}$ for every degree Fahr., and this is called the co-efficient of expansion. $70 - 40 = 30$ degrees Fahr. of increase, therefore we have this $1 + \frac{30}{460} =$ 1·0652 cubic feet. Or, we may find $\frac{1}{460}$ of a cubic foot which equals ·002173 × 30 (the number of degrees of increased heat) = ·06519, practically same as above. Therefore, 1 + ·06519 = 1·06519.—Answer.

QUESTION 9.—If 100 cubic inches of air weigh 31 grains Troy under a barometric pressure of 30 inches, what will 100 cubic inches weigh at a higher altitude, when the barometer stands at 26 inches, without any change of temperature?

ANSWER.—The weight of air at the same temperatures varies as pressure. Therefore, 30 : 31 :: 26 : 26·866.—Answer.

So that if 100 cubic inches weigh 31 grains at 30 bar., 100 cubic inches weigh 26·866 at 26 bar., at same temperature.

*(To be continued.)*

## SCIENCE AND ART EXAMINATIONS.

[We append below the questions given at the recent Examination on May 8th.]

*Time allowed three hours.*

### ELEMENTARY.

*You are permitted to attempt only seven questions.*

1. What is a mineral vein, and how does it differ from a bed or seam?

2. What are the Coal Measures, and how are coal and other minerals distributed in them?

3. Describe the tools required in boring by hand-power to a depth of 200 feet.

4. Sketch and descibe some form of drill for boring holes for blasting.

5. Describe the operations of sinking a pit 12 feet in diameter, and lining it with brick-work.

6. What are shafts, stopes, and winzes? Show the application of these terms in a sketch of a mine on a lode.

7. What methods of guiding skips or cages are used in vertical and inclined shafts respectively?

8. What is meant by splitting and regulating air currents?

9. How can a syphon be used in lifting water underground?

10. What precautions are necessary in approaching old workings likely to contain water?

11. What circumstances are to be considered in determining the length of stalls in long wall working?

12. Arrange the following minerals in order of destiny, and give the weight of a cubic foot of each:—Galena, quartz, pyrites, blende, and spathic iron ore.

### ADVANCED.

*You are permitted to attempt only seven questions.*

21. What is anthracite coal, and how is it prepared for use?

22. Describe the oolitic iron ore districts of England south of the Humber?

23. What is meant by the natural water level, and how does it effect the minerals in a lode?

24. How can cast-iron be used for securing shafts and levels?

25. Give some account of the use of electricity in blasting operations.

26. What are the chief points to be considered in selecting a system (pillar and stall or long wall) in working a coal seam?

27. Explain the terms rubbing surface, area, perimeter, and section of an airway, and determine them for a rectangular level 6 by 7 feet, 500 yards long.

28. What methods have been proposed for detecting small quantities of gas in the air of mines?

29. How would you keep the true alignment and gradient in driving a gallery?

30. Describe and compare the Guibal and Waddle fans.

31. What contrivances have been used for reducing violent strains on winding ropes?

32. In the dressing of minerals the vein-stuff may be finely powdered at once, or subjected to gradual crushing and sizing. State the conditions determining the use of either method.

## HONOURS.

*You are permitted to attempt only six questions.*

41. Give an account of the Yorkshire and Derbyshire coalfield, indicating districts where it is likely to extend below newer formations.

42. What are the principal mining districts in Europe producing spathic iron ore?

43. Describe a method of underground haulage, giving details of the mode of attachment of the tub to the hauling rope.

44. What causes have been assigned for the spontaneous ignition of coal in mines, and how should such fires be dealt with?

45. Describe some methods for preventing over-winding.

46. Sketch out a plant for winding 800 tons in a 10-hour shift from a depth of 400 yards, giving dimensions of engine, cylinder, drum, pit-head, and pulleys, and state the number and kind of boilers required, the working steam pressure to be 45lbs. per sq. inch.

47. Describe the method of treating gold quartz by battery amalgamation when there is a notable quantity of sulphide minerals in the vein-stuff.

48. Describe some method of working a coal seam where the excavation is stowed with rock as the coal is removed.

## COMPETITION QUESTIONS.

TO the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d.**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. In accordance with our custom the best answer to *each individual Question* will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by May 26th, 1894.
5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—Define the terms dip, strike, cleavage, and plane of bedding.

*Question* 2.—Describe, with sketch, how ladders are fixed in the shaft of a metal mine.

*Question* 3.—What are the advantages and disadvantages of vertical and inclined shafts respectively?

### ADVANCED.

*Question* 4.—Discuss the advantages of furnace and fan ventilation.

*Question* 5.—Describe, with sketch, *Poetsch's* freezing system of sinking shafts through watery strata.

*Question* 6.—Describe, briefly, the ordinary method of boring with rigid rods. Give sketch of surface arrangement.

### FIRST-CLASS.

*Question* 7.—Describe, with sketch, the *Pieler* lamp

*Question* 8.—Having two workable mines within ten yards of each other, how would you work them? What special precautions would you take if both mines were of a fiery character?

*Question* 9.—Assuming each of the above mines to be three feet six inches thick and the dip of the mine to be one in six, give sketches and describe the arrangements of a portion of the workings.

*Question* 10.—What h.p. would be necessary to haul 17 full tubs up an incline of one in five, at a speed of 200 yards per minute, the friction of tubs to be taken as $\frac{1}{28}$ of load.

GUIDE TO THE SCIENCE AND ART MINING EXAMINATIONS BY JOSEPH CARTER (PRICE 6d.).

We have received a copy of the above book and can recommend it to the Student in Mining. The particulars of the Examination Papers will be especially useful as these have been out of reach of the average student. Thirteen years' examination papers are also given (including the questions given this month), to many of which condensed answers have been given, which will prove invaluable to those hurrying for an Examination. The following are the contents (Coal and Metal Mining inclusive):—Subjects included in Examination—Character of Examination Papers—Elementary, Advanced, and Honours—Time and Particulars of Examination—Thirteen years' Questions with Condensed Answers. As our readers are aware, Mr. Carter is identified with this paper as writer of the Colliery Managers' Examination Questions and Answers.

## RECENT IMPROVEMENTS IN
# MINING MACHINERY & APPLIANCES
BY

MR. WM. SAINT, H.M.I.M.

(Address read before the Manchester Geological Society.)

*Continued from last issue.*

### SINKING.

The Kind-Chaudron method was designed to meet the enormous difficulties encountered in sinking shafts through rocks heavily charged with water, and many pits have been successfully sunk on this principal. The shaft is bored in two operations by percussive action in the ordinary way with suitable tools and appliances. A small shaft 4 or 5 feet diameter is first bored, and then the full size is accomplished in a similar manner. The small shaft serves to collect the *debris* from the outward boring and also forms a guide for the larger cutting tool. When a solid foundation is reached the water is dammed back by means of cast-iron tubbing; the bottom ring is packed with moss at the back, and is made to fit and slide within the one above it; the flanges are faced in a lathe, and as each length of tube is added the joint is made secure by means of sheet lead insertion and bolts and nuts. A diaphragm is temporarily fixed to one of the rings near the bottom, and a central tube is connected to it; the tubbing is lowered slowly by means of screws and iron rods, and as it sinks the water is forced up the central tube. The water supports most of the weight of the tubbing, and as it descends each suceeeding length is added until the sliding ring reaches the foundation. The upper tubbing, continuing to descend, compresses the moss packing between the bottom ring and the side of the shaft, thus forming a water-tight joint. Any water that may have accumulated inside the tubbing is removed, and the diaphragm taken out, and sinking may resume in the usual manner.

Triger's method of sinking through quicksands consists in the arrangements of a sheet-iron cyclinder sunk in the ground and divided into three compartments one above the other; compressed air of sufficient pressure to keep the water back is pumped into the lower chamber; air-tight doors are provided between each and the doors of the second and third chambers, and are allowed to be opened at the same time. Sinking thus proceeds until the rock head is reached and the ground made secure.

Poetsch's freezing method of sinking through quicksand has been tried with some success, the principal adopted being to freeze solid the water and sand in and around the proposed shaft, by introducing pipes into the ground and maintaining a circulation of chloride of calcium at a very low temperature; when this has been accomplished the inner portion of the frozen ground is worked out without blasting. Those who have experienced the difficulties and expense of sinking through a thick bed of quicksand will readily appreciate the value of a method by which such ground is made stable, until it can be secured by the proper shaft linings. This system appears to be a convenient and comparatively cheap method of dealing with a great thickness of running sand and water, which is occasionaly met with in colliery workings.

At Llanbradach a few years ago, Mr. Wm. Galloway introduced a movable scaffold for use in sinking pits, by means of which the walling may be carried on simultaneously with the sinking operations; the two ropes by which the scaffold is suspended in the shaft, are used as guides for the hoppet in ascending and descending; the scaffold is usually hung some fifteen or twenty yards from the bottom, and can readily be lowered or raised by screw winches. An auxiliary winding engine is used for lowering men and materials to the walling scaffold. The movable scaffold has been used with conspicious success, and has been instrumental in reducing the time that would otherwise have been required to win the coal seam.

We are also indebted to the same gentleman for an ingenious arrangement for filling the water at the pit bottom during sinking operations, by means of a vacuum. Air is exhausted from a large cylinder at the surface and a pipe is conducted from the cylinder to the bottom of the shaft, where a cock and a length of india-rubber hose, with one half of an instantaneous coupling, are fitted to it. The corresponding half of the coupling is fixed to the barrel, and when the connection is made with the vacuum cylinder on the surface, the air is exhausted on opening the cock, and the water rushes up and fills the barrel. A guage glass near the top indicates when the barrel is sufficiently full. The object is to dispose of the laborious method of baling, which is a serious item of cost in the course of sinking through water bearing strata.

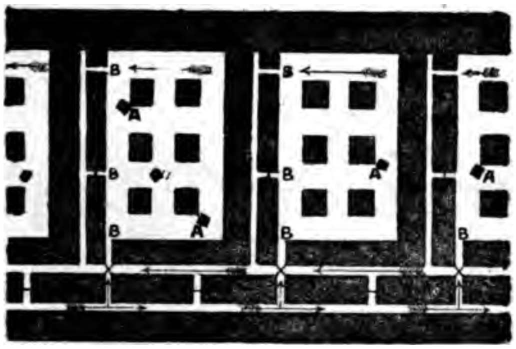
*(To be continued.)*

## ANSWERS TO QUESTIONS.

**In No. 11, Vol. 2.**

### ELEMENTARY.

*Question* 1.—Describe with sketch the square method of working thick seams of coal.



**The Square Method of Working.**

References:—

A A—Men-of-war  B B—Bolt-holes
X-Air Crossings  I-Stoppings
Direction of Air-current shown by arrows.

*Answer*.—The accompanying plan shews the square method of working. After the shaft is sunk two main levels are carried forward in the lower coal. From these roads the main workings, called "sides of work," are opened out in a square or oblong form about 50 yards on the side, and shut off by a pillar of coal about eight yards thick from the level, except at the entrance, by a narrow bolt-hole. The process now is to drive in the lower coal, gradually rising to the higher one. Stalls are opened forward and across, about ten yards wide, having pillars of about ten yards square to support the roof, and, if the roof appears bad, additional pillars ("men-of-war") are left about four yards square. The workmen get to the higher portion of the seam by standing on the seam already got, or on a scaffold. The pillars are often thinned to a smaller size, and when at length the roof begins to break the side of work is abandoned and the bolt-holes securely dammed up, as these sides of work are liable to spontaneous combustion. The ventilation is effected by means of a narrow drive, parallel to the side of work, being connected at intervals by small bolt-holes. The seams which this method of working is adapted to are from 25 to 35 feet thick.—Shadrack Chadwick, 601, Brookside Collieries, Westhoughton, near Bolton.

*Commended*.—S. Davies, J. E. Bibby, W. Walker, W. Sutherland, E. Colbeck.

*Question* 2.—What is the operation known as *holing* or *kerving* in coal mining. Give sizes and weights of tools employed.

*Answer*.—The operation of holing or kerving in coal mines is to take a strip of coal from the bottom, about twelve inches thick at the start, and thin it out to nothing at the back of the holing. If it is dirt you hole in, you take the same thickness at the back as at the front. Holing in coal mines depends on the nature of the strata you have to work in; if it is of a soft nature you take the whole twelve inches in front of you, but if it is of a hard nature you prick two or three inches thick as deep as you can and then you get the other down with the hammer and wedge, which makes more round coal. In some places they hole in the coal, other places in the dirt under the coal, other places in the dirt above the coal; in all cases it depends on the nature of the strata. Tools required: picks, hammer, spade, wedge, and sprags. The length of tools: blades, 14 or 17 inches; shaft, with socket for blades, 26 to 30 inches; spade, about 3 feet 6 inches; hammer, about 10 or 12 inches; shaft for hammer, about 24 to 27 inches; wedge, 9 to 10 inches. You will require sprags about 12 inches, if holing in coal; if holing in dirt under the coal you will require them longer, according to the thickness of the mine you work in and depth you hole. The average depth is about 3 feet. The weight of tools required: blade, with shaft and socket, is from $2\frac{1}{2}$ to $3\frac{1}{2}$ pounds; hammer, with shaft, about 7 or 8 pounds; wedge, 2 to 3 pounds; spades, 5 to 7 or 8 pounds. These tools vary according to the mine you work in.—Thomas Wilkinson, 25, Brancker Street, Over Hulton.

*Commended*.—S. Chadwick, H. Hall, E. Colbeck.

*Question* 3.—What are clayband ironstones, how do they occur, and what methods are adopted for working them.

*Answer*.—These clay-bands or iron-stones are often found as "nodules," made up of lenticular masses or balls lying close together in regular layers, inter-stratified among clay strata and shales. They are found under three separate and distinct conditions—either in the form of lodes, which is considered to be the result of igneous agency, or in "pockets" or "chambers." These have been formed by the action of water, and the cavities so formed are afterwards filled in with metallic matter; but clay-band iron-stone is generally found as beds or seams amongst the stratified rocks of the earth's crust, and those now worked are of the

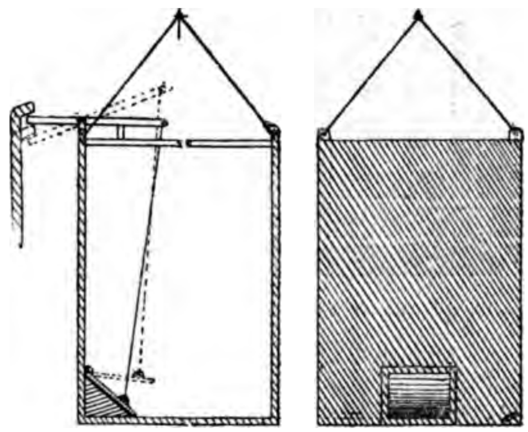
oolite, lias, and coal measures formations. The latter affords the chief supply of iron ore, although, to some extent, it is found in all, or nearly all, the formations from the earliest and most recent metamorphic formations. When associated with coal seams the total thickness of iron-stone got in one working is sometimes as little as three or four inches, and at the present date, coal-measures' ironstone is worked very profitably, with excellent quality and good thickness, as, for instance, the black-band iron ore of Lanarkshire. The iron-stone of North Staffordshire is worked in a bed four feet in thickness. Also, the black-bed ironstone near Leeds, Yorkshire, which varies from four inches to nearly four feet thick, is worked together with a seam of coal of sixteen inches average thickness. This is worked on the long-wall principle, and the gates are about twelve yards apart. The coal is worked off first for a distance of six to nine feet under, then the clay seam or iron bed is got down by drawing the sprags out, also with picks, hammers, wedges, and sometimes blasting is required to get it down properly. The modes of getting iron-stone in the following places, viz.: Leicestershire, Northamptonshire, Lincolnshire, and Rutlandshire, are by open or in form of quarrying work. But those found associated with coal seams are worked and removed, similar to the way of getting coals, by bord-and-pillar, such as the Upleatham Mines in Cleveland. The seam here is entered by drifts or levels on the hill side. The main headings are driven, and the bords are opened out at right angles to each other leaving rectangular blocks or pillars, usually ten by thirty yards. These pillars or posts are removed something similar to working the "brokens," or sliced off in pieces of varying lengths or lifts. By this it will be understood that these ironstones are got by quarrying, bord-and-pillar, and long-wall systems, thus depending upon how it is found, and the general thickness and nature of the cover.—Samuel Davies, Park Road View, Worsbro' Bridge, near Barnsley.

*Commended.*—J. Burrow, W. Sutherland.

### ADVANCED.

*Question* 4.—Describe how water is raised from mines by tanks. Describe with sketch an automatic working tank suitable for the purpose.

*Answer.*—Water is raised from mines by means of a water tank of wood or iron, which may be fitted on wheels and placed in the ordinary cage, or hung from the bottom of the cage. Sometimes the cage is taken off, and the water cistern is connected to the winding-rope and runs on the guide rods similar to the cage. The tank is provided with a hinged door or clack fitted to the end side, which opens by the pressure of the water when dropped into the sump, and when the tank is being raised the pressure of the water inside closes the clack. It is opened again at the



Section. End View.
Automatic Cistern.

surface by a lever whose inner end carries a chain which is attached to the clack. The lever is struck by a projecting arm fitted in the head gear, and the clack opens and allows the water to be discharged into a trough which is placed conveniently near. An ordinary spindle valve, opening upwards, is sometimes added, being fixed in the bottom of the tank so that it may fill more readily. This is a very efficient means of dealing with water, as the time taken to fill the tank, wind to the surface, and discharge again is very short.—Samuel Thorpe, Chevet View, Ryhill, Wakefield.

*Commended.*—G. Daykin, R. Anderson.

*Question* 5.—Describe the Longwall method of working coal in two of its varieties.

*Answer.*—The two methods I intend to describe are the longwall advancing mode, and the longwall retreating mode.

Longwall Advancing.—This method of working is very simple, the whole of the coal being taken out in one operation. In this method, as in any other method of working, it is absolutely necessary that pillars be left to support the shafts. Two or more places are driven from the shaft bottom, being continued until the shaft pillars are left of sufficient size. The workings are then started in a wide

face several hundred yards in length, thus extracting all the coal as they advance towards the boundary. It will be seen that as the workings advance they are leaving behind more and more goaf. Roadways, or gateways as they are often termed, require to be left open for ventilating and conveying purposes, therefore they require some support to keep them open. Consequently, the dirt that is in some cases worked with the coal, and the stone that is ripped down from the roof, goes to form pack-walls. Packs are generally nine feet wide, but for the engine plane it is advisable to have twelve-feet packs. In a thin seam the gateways are generally about 15 yards apart, and in some cases where the seam is thick it is necessary to have them 44 yards apart.

Longwall Retreating.—In this method narrow places are driven direct to the boundary, being holed every 44 yards for the purpose of ventilation. When the boundary is reached, a wide face is opened out and worked away from the boundary to the shaft. This method is applicable in a thick seam with no dirt partings, and also where the seam dips considerably and gives off a lot of water. It gives good results where there are gob fires, and in a seam containing many faults it is much better than the advancing mode. It has the advantage of having fewer roads, which are kept right at a much less expense, and at the same time these roads are gradually decreasing in length. However, the retreating mode has one great disadvantage, and that is it will hardly pay the expense of working until the boundary is reached. The advantage of the first method is that a large quantity of coal is obtained soon after the opening of the pit, and if the shafts are sunk at the extreme dip near the boundary, it is a greater success than the retreating method under the same circumstances.—Wm. P. Laws, 25, Pilgrim Street, Murton, Sunderland.

*Commended.*—G. Daykin, A. H. Meakin, G. A. Hawes, W. Atherton, R. Anderson.

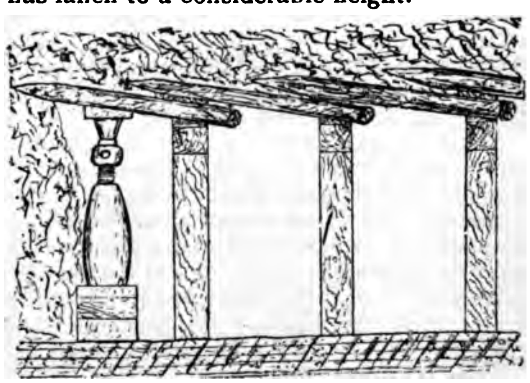
*Question* 6.—What are the principal methods in use for signalling from the bottom of a deep mine to the surface, and of indicating the position of the cage in the shaft ?

*Answer.*—The methods principally used for signalling in winding shafts are (1) the common lever and hammer or bell, and (2) electricity. The C.M.R.A. requires that there shall be in every shaft arrangements for communicating distinct and definite signals between the shaft, top, bottom, and every intermediate working level, and this rule is carried out by the above methods. No 1 consists of a common lever and hammer. There is a small wire rope which hangs down the shaft, with a lever at one end and a hammer or bell at the other. The lever has to be pulled to make the hammer give the required number of raps. To make it distinct the hammer strikes on a plate which rings like a bell. No. 2, electric signals, are made up of the following :—(1) the battery, (2) the bells, (3) the connections. The battery is placed in some convenient place, and then the wires are taken from this point down the shaft—there being two wires, the "positive" and the "negative" current. The bells are placed at the pit bottom, surface, and in the engine house. To indicate the position of the cage in the shaft there is fitted up in the engine house a winding indicator or a dial, this also being required by the C.M.R.A. It consists of a vertical frame fitted with a block which slides up and down the frame. Attached to this block is a chain which is wound round the drum shaft. When the cage is at bank the block is at the top of the frame, and then it descends with the cage till the cages are at the meetings. Then the block ascends, and as soon as the cage is about seven fathoms from bank this indicator rings a bell so as to warn the engine man of the ascending cage nearing the surface, and by this arrangement the engine man can tell the position of the cages in the shaft. The dial being like a clock, one round of the pointer means the cages going once down or up the shaft.—George Daykin, 24, High Gurney Villa, nr. Bishop Auckland.

*Commended.*—W. P. Laws, A. H. Meakin, S. Thorpe.

### FIRST-CLASS.

*Question* 7.—Describe with sketch how you would proceed to re-open a roadway which has fallen to a considerable height.



Longitudinal view of roadway.

*Answer.*—The accompanying sketch illustrates a system of re-opening places where the roof has broken and fallen to a considerable height. To open it out again I would commence by setting a pair of couples or square frames of timber, and then drive strong piles over the frames into the fallen material, with the leading points slanting upwards to give room for the next pair of couples to be set, with its cross timbers to pass between them. While driving the piles and removing the dirt beneath them I would set props under the leading ends of them to keep them up until they were driven far enough. It might be necessary sometimes to use the screw-jack to force the leading end of the piles up sufficiently to allow room for the next pair of couples and piles, in this way getting pair after pair in until the whole length of the broken ground was opened and made quite secure again.—THOS. BANKS, Church Road, Haydock, Lancashire.

*Commended.*—W. Littler, G. W. Scougall.

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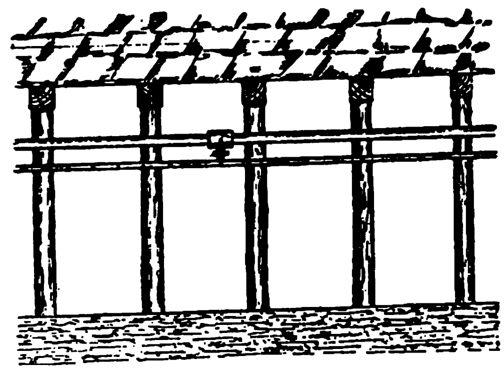
*Question* 8.—How would you arrange the winding in a pit with two mouthings at different levels; coal being wound from both?

*Answer.*—In arranging the winding for the two mouthings very much would depend upon the quantity of coal expected to be wound from each. If there was an equal quantity of material to be drawn from each mouthing, then the best and wisest policy would be to so arrange them that one cage would go to one mouthing and the other cage to the other mouthing. In one of the shafts at the Douglas Bank Colliery the yard and Arley seams, which are at different depths, are wound in the above manner. The yard cage is being unloaded at the top while the Arley cage is being loaded at the bottom, and *vice versa*. To accomplish this the winding drum is made of two different diameters—the larger diameter for the deeper seam and the smaller for the shallower, and are so adjusted that both cages travel to their respective seams in the same space of time.

If, however, a considerale quantity was expected to be wound from one seam at one mouthing, and only a very small quantity from another mouthing at a different depth, it would be advantageous (supposing the greatest quantity was to be wound from the deepest mouthing) to have both cages going to the deeper mouthing—that is, one at the top when the other was at the deeper mouthing, and the coal from the upper.—WILLIAM LITTLER, 234, Woodhouse Lane, Wigan.

*Commended.*—G. W. Scougall.

*Question* 9.—It has been decided to use water jets in the main haulage road of a dusty mine to avoid the risk of a coal dust explosion. Show with sketches how you would arrange the water pipes and what arrangements would you make to obtain fine sprays.

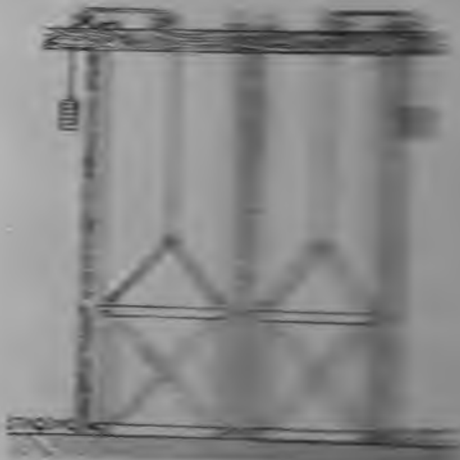


**Section showing Water-pipes.**

*Answer.*—When a current of air leaves the down-cast and passes through the workings of a mine its temperature is raised, and thus it has a tendency to increase the quantity of dust, as its capacity for absorbing moisture i- increased. This is especially the case in de- and dry mines, and to keep the air in as p a state as possible some system of wat- must be adopted. I shall recommen BLAKEMORE's patent watering appara is very simple and likewise effec consists of a main pipe which ext from the surface or from the tul along the roadway to be water pipe, connected at intervals t has continuous perforations being so small as to produ of fine spray. The vent kept cool, and the dust A cock may be attach to the shaft, also at the pipes, to regu There are several this as being sir The drawing is omitted to sta 60 or 70 pour through the Bell's Plac

th

o




FORTNIGHTLY.
ONE PENNY.

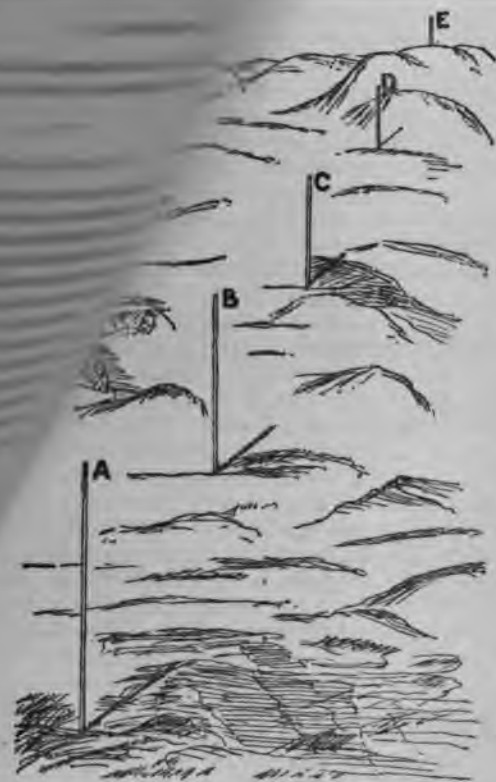



Fig. 56.

staffs must be placed in the same line between them. To accomplish this the surveyor stands at the staff at A, and fixes his head so that he can look with one eye on each side of the staff. An assistant then holds a staff at some point between A and E and is directed by the surveyor to the correct line, as he will be able to see exactly when the staff is in line with A and E, and this takes place when the staff E is hidden from sight by the intermediate staff. In the same manner, more

## ANSWERS TO CORRESPONDENTS.

RECEIVED :—Competitor, H. Harfield, Elementary Competitor, T. Martland, S. Fairhurst.

W. Perkin (Whitehaven).—Mr. Carter's next set of Answers to Colliery Managers' Examination Papers which appear in our paper will be of the district you mention. Shall be glad to give you any information in our power with respect to these Examinations.

Patentee (Alfreton).—You should consult a reliable patent agent, who will most likely be able to inform you whether your invention is worth putting on the market; or, if you do not care to do this, send us particulars, and we will give you our ideas. Strict secrecy will be maintained. The cost of a provisional patent for nine months, during which time you can practically test it, but not put on the market, is from £3 to £4; full patent about £12.

Surveying Apprentice (Bishop Auckland).—A good book on Mine Surveying is B. H. Brough's. Price 7/6.

INCLINE MEASURING.

Sir.—Can you give me a simple rule for converting degrees into dip per yard, and another for deducting the links per chain on an incline to get the level measurement? I have got a table giving this information, but I cannot always have the book in my pocket.—MINE SURVEYOR.——————A simple rule, sufficiently accurate for small angles, for converting degrees into dip per yard is the following:—Divide the number of degrees into 57, and the result will be the answer. Thus 6 degrees: $\frac{57}{6} = 9{\cdot}5 = 1$ in 9·5. Correct answer is 1 in 9·51. Again, 20 degrees: $\frac{57}{20} = 2{\cdot}85 = 1$ in 2·85. Correct answer is 1 in 2·74. 15 degrees: $\frac{57}{15} = 3{\cdot}8 = 1$ in 3·8. Correct answer is 1 in 3·73. We thus see for angle less than 20 degrees this rule is fairly correct. To find how much must be deducted per chain to change incline measure to true level measure. Square the number of degrees, multiply by $1\frac{1}{2}$, and cast off two figures as decimals. Thus 2 degrees: $2 \times 2 \times 1{\cdot}5 = 6 = {\cdot}06$ links per chain to be deducted. 10 degrees: $10 \times 10 \times 1{\cdot}5 = 150 = 1{\cdot}5$ links per chain to be deducted. 20 degrees: $20 \times 20 \times 1{\cdot}5 = 600 = 6$ links per chain to be deducted. 30 degrees: $30 \times 30 \times 1{\cdot}5 = 1350 = 13{\cdot}5$ links per chain to be deducted. The greatest error in these examples is in the 30 degrees, whose correct answer is 13·4. It will be seen, therefore, that these rules are sufficiently accurate for ordinary use.—EDITOR.



## EDITORIAL CHAT.

OUR Competition Questions have for some time been a very important and satisfactory portion of our paper, and revolves great credit on our readers, but we are informed by a correspondent whose contribution we published last issue, that the method upon which we conduct it is scarcely the proper one, and we are bound to agree with him and plead guilty. Now, when once we are convinced that we are doing wrong, we waste neither time nor trouble in rectifying it; and we have, after due deliberation, and with the help of our correspondents, arrived at a very satisfactory conclusion, at least in our minds, and we cannot see how it will affect the competitors otherwise.

As our readers are fully aware, our custom was to give ten Questions to be answered competitively by our readers, a uniform award of one shilling being given to the competitors who sent the best answers to the questions. The questions are classified into three stages, viz.: Elementary, Advanced, and First Class, and a competitor could choose any stage in which to answer questions; and it is evident that advanced student of many years' study would answer the Elementary questions better than the beginner for whom the questions are intended, and would thereby deprive him of all chances of an award. Again, the Elementary questions for the most part, require far less work in answering, and it scarcely seems fair that the same award should be made for these questions as for the more advanced.

We have therefore determined to establish a new regime, commencing with the questions given in this issue. Instead of giving a uniform award for each question, the awards will be given to the competitor who sends the best *set of answers* in each stage. Thus, in the Elementary Stage the award is to be 2s. 6d.; in the Advanced, 3s. 6d.; and in the First Class, 4s. 6d.

By these means we hope the competitors will aspire to answer the questions in the highest possible stage. This arrangement will not interfere with our present system of publishing the best answer to *each individual* question, and the sender's name and address, but there will be only three awards instead of ten.

We are positive the whole of the competitors will welcome this arrangement as all have a more equal chance, and the honour of having the name published as the sender of the best answer to each question, will be the same as before.

There is already quite an army of competitors, and we feel sure these arrangements will have the effect of augmenting it. Apart from the pecuniary benefit, and the honour of sending the best answer, it is the best possible means a student could adopt for acquiring information, and stamping it indelibly upon the mind.

THE EDITOR.

Literary communications to be addressed to the Editor, " Mining," Clarence Printing Works, Wallgate, Wigan.

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# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MIN

No 14. Vol. II. SATURDAY, JUNE 2, 1894. FORTNIGHTLY. ONE PENNY.

**CONTENTS.**



## EASY LESSONS ON MINE SURVEYING

**For Beginners.**

*Commenced in No. 2, Volume II.*

### MEASUREMENTS.—(Contd.)

STAFFING OUT.

IT will be apparent that a *straight* line could not be measured of any considerable length without some marks to keep the direction. In many cases a conspicuous tree, chimney, or steeple serves to keep the direction, but these do not always come in the line of sight, and some other artificial means must be provided. Staffs of from seven to ten feet in length, shod with iron, and painted in feet alternately red, white and black so as to be seen distinctly, are fixed in the ground at intervals of about two chains or more, exactly in the line which it is required to measure. Let us assume that the distance between A and E (Fig. 57) is required, and that a staff placed at E can just be seen from the point A, but not distinctly enough for the measurers to see quickly, then a few more

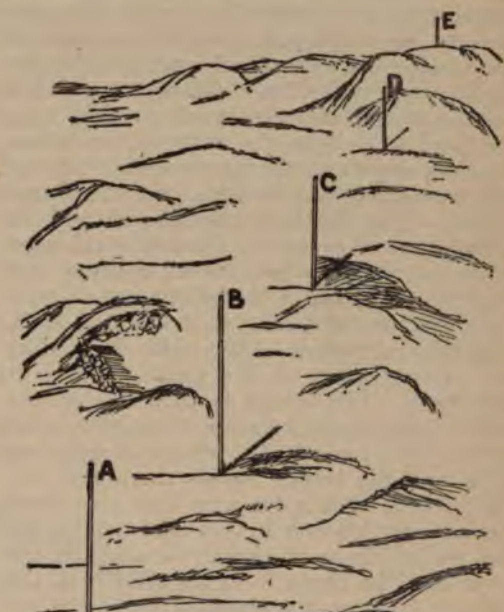


Fig. 56.

staffs must be placed in the same line between them. To accomplish this the surveyor stands at the staff at A, and fixes his head so that he can look with one eye on each side of the staff. An assistant then holds a staff at some point between A and E and is directed by the surveyor to the correct line, as he will be able to see exactly when the staff is in line with A and E, and this takes place when the staff E is hidden from sight by the intermediate staff. In the same manner, more

intermediate staffs may be fixed. Again, assume that a line AB is chosen, and it is required to produce it in the direction of E. The surveyor takes a staff and goes forward to C looks back in the direction of A, and places the staff in the position from which B hides A from sight. He then goes on to D, and fixes his staff as before. It is of course necessary to be able to see at least two staffs before a third can be put in line, but for lines of several chains in length it is best to fix the staffs near enough to each other to enable three to be seen when putting in a fourth.

### To Measure a Line.

The line having been staffed out, it now remains to be measured. To do this, two persons are employed: one for the front of the chain—the "leader;" and one for the hindermost end—the "follower." Small arrows or iron skewers, about one foot long, are used to denote the ends of the chain. Many surveyors use ten arrows when chaining, and some even nine, but the writer has found eleven to be the best number, as will be apparent as we proceed. The leader takes ten arrows in one hand and the other arrow and the end of the chain in the other, and pulls the chain in the direction of the staff at B. The follower stands at the point A, holding the other handle of the chain until it is stretched. The leader is then put in the correct line by the follower moving his hand to the right or left. The chain is stretched tight, and the leader pushes the arrow into the ground and advances another chain forward, the follower in this case holding his end of the chain at the arrow stuck in the ground. The chain is again stretched, the follower takes up the arrow at his end of the chain, and thus they proceed until the eleven arrows are employed. Of the arrows one will be at the last point measured to, and the other ten will be in the hands of the follower who comes forward with them and gives them to the leader, the one arrow being left in the ground. The leader then proceeds as before, and when it is necessary to know the number of chains measured it is sufficient to count the arrows in the hands of the follower and add them to the number of tens which have been measured. Now, what happens when only ten arrows is this:—The ten arrows having been employed, before the leader can proceed again so as to keep the count correct he must have his ten arrows, in which case the follower must keep the mark with his foot at the risk of getting it wrong. The most practical and correct number to use, therefore, is eleven. Now, suppose the arrows have been exchanged six times, and the follower has five arrows and there is an arrow down, then the number of chains measured will be 66, or 6600 links.

### Incline Measuring.

In order to get the correct level measurement on inclines or slopes, it is necessary to ascertain the angle of the inclination and deduct a certain length from the measurement, or to take short measurements up the slope—the chain being held horizontal. For example, if the gradient was not too great 50 links might be taken at each operation—the leader on the top of the slope holding the 50 on the ground, and the follower holding the end of the chain to the required height. When the chain has to be held up a staff should be placed at the mark exactly perpendicular, and the chain placed to it, in order to ensure its being immediately over the mark.

(*To be continued.*)

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## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

(*Continued from No. 13, Vol. II.*)

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

**Subject.—**

**PRACTICAL MINING.**

Question 1.—Describe the provisions of the Coal Mines Regulation Act of 1887 with regard to (*a*) Reporting of Accidents, (*b*) Shaft Signals, (*c*) Man-holes.

Answer.—(*a*). All accidents in or about any mine, whether above or below ground, when personal injury or loss of life results, shall be reported (by the agent, owner, or manager of mines) in writing to the Inspector of the district within 24 hours after the accident, such notice must specify the character of accident, whether by explosion or otherwise, also the number of persons killed or injured by such accident. Should death result to the person or persons injured, of which notice is required to be sent under this section, notices in writing of the death of the person or persons shall be sent to the Inspector of the district on

behalf of the Secretary of State within 24 hours after such death comes to the knowledge of the owner, agent, or manager.

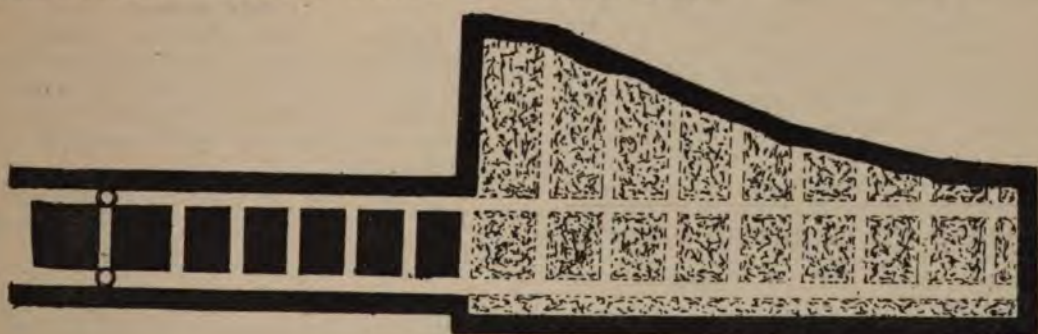
(*b*) Every working shaft must be provided with some proper means of communicating distinct and definite signals from the bottom of the shaft, and from every entrance for the time being in use between the surface and the bottom of the shaft to the surface, and from the surface to the bottom of the shaft, and to every entrance for the time being in use between the surface and the bottom of the shaft.

(*c*) All underground planes on which persons travel, which are self-acting or worked by an engine, windlass, or gin, if exceeding 30 yards in length shall be provided in every case with sufficient man-holes or places of refuge at intervals of not more than 20 yards, or if there is not room for a person to stand between the side of a tub and the side of the plane, then (unless the tubs are moved by an endless chain or rope) at intervals of not more than 10 yards. On roads when the load is drawn by a horse or other animal underground and on which persons travel, man-holes shall be provided at intervals of not more than 50 yards, every such place of refuge shall be of sufficient length and at least 3 feet in width between the wagons running on the road and the side of such road. All man-holes to be kept constantly clear.

QUESTION 2.—Give a description of the coal, floor, and roof of a seam you are well acquainted with, and describe fully the method of working it, and the advantages of the method adopted as compared with any alternative method.

ANSWER.—The following is a description of a mine with a light blue metal roof, moderately hard, coal rather tender, and divided in two parts with 6″ to 18″ of dirt in middle. Floor consisted of a dark warrant, moderately hard. This was worked on the Longwall principle. The colliers holed in the dirt between the coals, and this they packed behind them as a support for their working faces; also the roof in the main road had to be roofed down and this dirt was also stowed in places for packing and sometimes in old disused drawing roads. The floor was left untouched. The advantage derived by working this mine on the Longwall principle was that when cutting narrow places in the pillar and stall method the floor lifted considerably, and the band of dirt between the coals became very troublesome, causing at times a great amount of trouble and expense. Advantages gained were that the dirt between the coals came in useful for packing working places, the roof in the main roads could be got down fairly well, and this was also utilised for packing, the floor to a certain extent ceased lifting; also greater percentages of round coal.

QUESTION 3.—Make a sketch in ink, illustrating your answer to No. 2 Question, giving distances between the roads. ANSWER.—Drawing roads 15 yards apart.



Longwall Workings.

QUESTION 4.—Referring to Nos. 2 and 3 Questions, give under the several heads of a cost sheet the approximate cost of production per ton of coal raised.

| ANSWER:— | s. | d. |
|---|---|---|
| Collier ... ... ... ... | 3 | 0 |
| Yards and Incidental Expenses. | 0 | 3 |
| Daymen... ... ... ... | 0 | 9 |
| Surface ... ... ... ... | 0 | 7 |
| Stores ... ... ... ... | 0 | 5 |
| Mine Rent ... ... ... | 0 | 6 |
| | 5 | 6 |

In addition to this there is the management depreciation, etc., all of which varies considerably at different places. This is only an approximate cost.

QUESTION 5.—Make sketches in ink of the timbering you would adopt for sinking a pit, 15 feet diameter, through loose ground, and give an estimate of the cost of the prepared timbering for each yard of sinking.

ANSWER.—Timber is first used in sinking a shaft through loose ground, and is usually fitted by the following method. (The pit is marked out about 2 or 3 feet larger than intended and sunk down about 6 feet.) Cribs or curbs are used, made of oak or elm, 5½ inches square, segments are fitted together at the surface, then sent down and strongly nailed together in the pit by means of the overlapping cleats. The first crib is placed on the bottom of the pit, and then "backing deals" of fir, about 9 feet long and 7 inches or 8 inches wide and 1 inch thick, are placed behind it, and these are projected 3 feet above the surface. Another crib is put together and is placed 2 or 3 feet above the first, as required, and supported by "punch props," as shown in sketch. In ordinary ground, one crib each yard will suffice, but in tender ground it may be well to put a crib in every 2 feet and to back them up with backing deals 1½ inches or 2 inches thick. When this is done another 6 or 9 feet is taken out of a reduced diameter. The bottom is then cut out to the size first marked out, and another two or three cribs are put in with backing deals and punch props as before. During this process "stringing deals" are nailed over the cribs already in so as to keep them in their right place. Sometimes it is requisite to suspend the whole of the timber from balks placed at the surface. Cost, from £4 10s. to £6. For sketch see No. 7, Vol. II.

*(To be continued.)*

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—Miner, M.P., W. Collingwood, and Colliery Engineer.

J. R. (Haydock)—The rules respecting the Competition Questions are clearly defined in our paper, and we cannot undertake the task of telling every competitor why he did not receive an award. Your answer was doubtless correct, but the question was a mathematical one, and in such cases many correct answers are received, and, as only one prize is to be given, we award it to the one who sends in the best paper with respect to neatness or clearness. We are pleased to say that the greater part of our competitors answer the questions for the good which they derive from it apart from any pecuniary benefit, and, up to the present, our judgment in awarding the prizes has not been questioned, and we hope it will continue so.

## COMPETITION QUESTIONS.

TO the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d.**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. In accordance with our custom the best answer to *each individual Question* will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by June 9th, 1894.
5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—Describe with sketch how the forebreast of a level is ventilated.

*Question* 2.—What methods of guiding skips or cages are used in vertical and inclined shafts respectively?

*Question* 3.—What is an adit level? Give sketch and mention some of the most remarkable.

### ADVANCED.

*Question* 4.—Explain the terms rubbing surface, area, perimeter, and section of an airway, and determine them for a rectangular level 6 feet by 7 feet, 500 yards long.

*Question* 5.—How can cast-iron be used for securing shafts and levels?

*Question* 6.—Give some account of the use of electricity in blasting operations.

### FIRST STAGE.

*Question* 7.—Describe the colliery with which you are best acquainted, giving details of surface and underground arrangements, method of haulage and working, and anything which you may deem interesting. Give sketches.

[P.S.—Only one Question is given in the First Stage as the answer will be of considerable length.]

## RECENT IMPROVEMENTS IN MINING MACHINERY & APPLIANCES

BY

MR. WM. SAINT, H.M.I.M.

(Address read before the Manchester Geological Society.)

*Continued from last issue.*

### BOILERS.

Recent improvements in the manufacture and quality of steel have facilitated the economical production of large high-pressure steam boilers. Twenty years ago 60lbs. pressure was considered high, but now, in colliery work, we find many Lancashire boilers working at 80lbs., 100lbs., and even 150lbs. per square inch; and elaborate machinery is used in their manufacture for flanging, planing edges, and rivetting.

The economical advantages of working steam expansively are becoming more appreciated, and there is a general tendency towards increased pressures.

Movable fire-bars, fed by hand or mechanical stoking enable very inferior fuel to be burnt, and are also very effective in preventing the emission of dense smoke. The slack is fed at the front of the fire only, and the action of the bars is to carry the fire forward. The supply of slack is so regulated that all the fuel is consumed by the time it reaches the end of the bars, where the ashes and clinkers fall.

### PUMPING.

The Cornish pumping engine was the first direct-acting expansive working engine, and its economical performance is well known. But it did not adapt itself to variable loads caused by loss of water in the pumps, occasional breakage being the result. To meet this defect many of them have been fitted with Davey's differential gear for controlling the valves with satisfactory results. Its first cost, however, is great. As alternatives, Hawthorn, Davey, and Co.'s horizontal compound condensing engines, connected to quadrants which give the necessary vertical motion to the pump rods in the shaft, are largely adopted. This engine, like the Cornish, depends for its expansive working on the mass of its moving parts. The chief improvements consist of the addition of pausing gear, which ensures an interval at the end of each stroke, thereby allowing time for the valves of the lift to settle down before the commencement of the succeeding stroke; a trip gear, by means of which the exhaust from the H.P. cylinder is automatically stopped in case of a sudden rush or accident, thus forming a cushion which gradually stops the engine without shock. The arms of the quadrants are less than 90°. The main valves (exhaust and steam admission) are controlled by automatic gear, and an expansion can be obtained without "wire-drawing" the exhaust. By these means 8 to 12 expansions can be obtained, according to the initial pressure of steam. In connection with these engines hydraulic pumps are sometimes fixed in duplicate at the pit bottom or in dip workings for working the lower lift. One is usually capable of doing the work, the other being kept as a reserve. These receive the motive power from the rising main of the upper lift, suitable arrangements being made for starting them when under water, should they become submerged.

In other instances direct-acting differential engines are placed near the bottom of the shaft, the water being pumped to the surface in one lift and the steam supplied by boilers fixed either on the surface or underground.

Pumps of the Worthington type are also largely used. They have two sets of cylinders and rams; the slide valve of one cylinder being actuated by a lever moved by the piston rod of the other cylinder. When at work, one ram or the other is always in motion, and as the delivery of the water is continuous there is an entire absence of vibration and shock.

Messrs. Bailey and Co., of Salford, manufactured a vertical pump, specially adapted for sinking purposes. It was first used at the Denaby Main Colliery, from which it takes its name. It is very simple in construction, occupies little space, has large valve area, is not liable to get out of order, and is very convenient for suspending in the shaft. It is said to use less steam than many other direct-acting pumps designed for a similar purpose.

A novel method of utilizing water as a means of transmitting power for pumping purposes below ground is that patented by Mr. Joseph Moore, in which the power rams are actuated by two columns of water in connection with ordinary rams, worked by a steam engine fixed on the surface. The reciprocating motion of the engine being imparted to the underground pumps.

(*To be continued.*)

## FATAL ACCIDENTS IN AND ABOUT MINES.

The following Summary of Fatal Accidents in and about the mines of Great Britain and Ireland, during the year 1893, will prove interesting to our readers, insomuch that it tends to attract our attention to the best means of their prevention. For purposes of comparison the number of fatal accidents which occurred during the year 1892 are also given.

| SOURCE OF ACCIDENTS. | No. of Persons fatally injured during 1892. | 1893. |
|---|---|---|
| *Explosions of Firedamp* | 123 | 158 |
| *Falls in the Mine:—* | | |
| Falls of Sides | 97 | 98 |
| Falls of Roof | 338 | 313 |
| | 435 | 411 |
| *In Shafts:—* | | |
| Overwinding | 0 | 0 |
| Ropes and chains breaking | 3 | 6 |
| Whilst ascending and descending by machinery | 29 | 28 |
| Falling into shaft from surface | 7 | 6 |
| Things falling from surface... | 3 | 5 |
| Falling from part-way down | 25 | 18 |
| Things falling from part-way down | 10 | 15 |
| Miscellaneous in shafts | 14 | 25 |
| | 91 | 103 |
| *Miscellaneous Underground:—* | | |
| By explosives | 23 | 15 |
| Suffocation by gases | 25 | 14 |
| Irruptions of water | 9 | 0 |
| Falling into water | 0 | 1 |
| On inclined and engine planes | 77 | 61 |
| By trams and tubs | 80 | 69 |
| By machinery underground | 7 | 4 |
| Sundries underground | 34 | 101 |
| | 255 | 265 |
| *On Surface:—* | | |
| By Machinery | 15 | 16 |
| Boilers Bursting | 6 | 0 |
| Railways and Tramways ... | 46 | 59 |
| Miscellaneous on surface ... | 45 | 44 |
| | 112 | 119 |
| Gross Total... | 1016 | 1056 |

In 1893 there were 806 fatal accidents, causing 1056 deaths.

In 1892 there were 847 fatal accidents causing 1016 deaths.

In mines classed under the Metalliferou Mines Acts there were, in 1893, 39 fata accidents, with 65 deaths; while in 1892, 4 fatal accidents, with 52 deaths.

NUMBER OF PERSONS FATALLY INJURED I EACH DISTRICT.

| | |
|---|---|
| Northumberland, Cumberland, and North Durham | 8 |
| South Durham, Westmoreland, and North Riding of Yorkshire | 7 |
| Cleveland (ironstone) | |
| Yorkshire (142 caused by explosions)... | 21 |
| Do. (ironstone) | |
| Lincolnshire (ironstone) | |
| North and East Lancashire | 5 |
| Ireland | 1 |
| West Lancashire and North Wales ... | 7 |
| Derby, Nottingham, Leicester, and Warwick | |
| North Stafford, Cheshire, and Shropshire | 4 |
| South Stafford and Worcestershire ... | 4 |
| Monmouth, Gloucester, Somerset and Devon, and parts of Brecon and Glamorgan | 5 |
| South Wales | 22 |
| East Scotland | 6 |
| West Scotland | 4 |
| Do. (ironstone, etc.) | |

SUMMARY, SHEWING AT WHAT HOURS AFTE THE COMMENCEMENT OF THE SHIFT THE FATAL ACCIDENTS HAPPENED.

| | Under ground. | Above ground. |
|---|---|---|
| During the First hour ... | 81 | 16 |
| ,, Second ,, ... | 77 | 10 |
| ,, Third ,, ... | 85 | 9 |
| ,, Fourth ,, ... | 70 | 10 |
| ,, Fifth ,, ... | 71 | 18 |
| ,, Sixth ,, ... | 92 | 11 |
| ,, Seventh ,, ... | 70 | 10 |
| ,, Eighth ,, ... | 54 | 7 |
| ,, Ninth ,, ... | 45 | 10 |
| ,, Tenth ,, ... | 35 | 10 |
| ,, Eleventh ,, ... | 8 | 2 |
| ,, Twelfth ,, ... | 0 | 1 |
| More than the ,, ,, ... | 0 | 2 |

**Colliery Managers' Exams.**

**Eighteen of the successful candidates in the Firs Class Exam., and twelve in the Second Class Exam. at Cardiff, in April last, are students of the Universa Mining School, Derby, conducted by Mr. T. A Southern, *late* H.M. Inspector of Mines.**

## ANSWERS TO QUESTIONS

### In No. 12, Vol. 2.

#### ELEMENTARY.

*Question* 1.—State the qualities and dimensions of the varieties of timber most suitable for use in mines.

*Answer*.—The best kinds of timber suitable for mining purposes are:—Oak, elm, larch, Norway fir or red deal, Swedish or yellow deal, and American pitchpine. The oak and elm being a hard timber are useful for cribs, &c. They are brought to the pit in huge lengths, and are cut up in lengths suitable for their purposes. Norway fir is very valuable for all underground work, as it will bend considerably before breaking. It is imported in its round state, with the bark merely stripped off, varying in width from 6 inches to 18 inches, and in lengths of 30 or 40 feet. Swedish timber is usually imported in square baulks, and is suitable for cutting into battens and backing deals. It is not quite so strong as Norway timber. Small oak and fir poles, which may be often obtained where plantations are being thinned, are very useful for sleepers and props. They can be cut down the middle and laid with their flat sides to the floor, and the rails laid on to the round sides.—ALBERT HY. MEAKIN, Mansfield Road, Eastwood, Notts.

*Commended*.—J. H. Senior, W. H. Hardy, A. Boyd.

*Question* 2.—Describe the preparatory operations in the commencement of the sinking of a shaft.

*Answer*.—After the coal or any other mineral seam has been proved and some guarantee, or at least a fair prospect, that coal or other minerals really exist under an estate, and in sufficient quantities to make a fair return for the money invested, the operations in sinking are commenced. Before commencing the actual operations for sinking, we must decide—firstly, what size and form of shafts we are going to have; secondly, in what position we intend having the shafts.

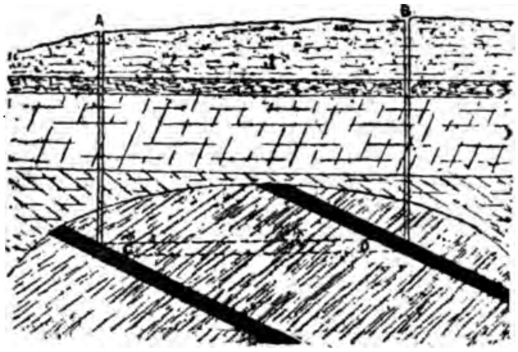
SIZE OF SHAFT.—This will be determined by the probable duration of the colliery, and the mineral expected to be raised, etc. In these days of rapid winding it is essential that the cages should have plenty of room to pass each other in the shaft, especially if wire conductors are to be used. Consideration should also be given as to the possibility of the seam making much water, and whether much haulage rope will be needed, because, if these contingences should arise, pump columns and haulage boxes may have to be put in the shaft, and thus reduce its working area. Therefore, it is wise to have sufficient room in the shaft.

FORM OF SHAFT.—The one generally adopted in this country is the circular. This is the strongest form and presents the least rubbing surface to the air for a given area.

POSITION OF SHAFT.—In fixing upon the position of our shaft our guiding principle should be to place it in such a position as to command an easy entrance into the market, that is, near a railway or canal, and, if possible, near a road, and to work the whole of the royalty in the cheapest way. For this purpose we should have to pay due regard to the dip of the seam, so as to be able to deal with the underground haulage and pumping. We should also take care to avoid sandy and watery ground. In the ordinary method of sinking the ground is first marked out three or four feet wider than the diameter of the intended finished size, and, as the first portion of sinking will be in soft ground, it can be excavated with pick and shovel until the hard stone is reached. When ten or twelve feet has been removed a round of cribs, made of oak or elm about five inches square, are laid at the bottom, which must be perfectly level. About three feet above this is placed another crib supported on short props set upon the lower crib, Then another crib is placed above this, and so on, until the topmost crib is two or three feet above the surface, Behind these cribs backing deals are wedged up. The whole set is then bound together by long stringing deals nailed on the inside of all the cribs. The work is then continued until a good solid bed is reached, a bricking ring or walling ring is then laid, and the shaft bricked up.—JOHN HY. SENIOR, 16, Thompson Row, High Street, Rawmarsh.

*Commended*.—T. Meford, G. Brown.

*Question* 3.—Show, with sketch, how the proving of a coalfield by means of a few boreholes may be delusive.




A B—Boreholes. C D—Supposed position of seam.

*Answer.*—An illustration of the difficulty of obtaining trustworthy information from borings in certain cases, unless they are numerous, is afforded by sketch, which represents the strata met with in two bore-holes A and B, 120 yards apart, at the Cornforth Colliery, near Durham. In this case there happened to be two seams of coal of similar appearance, and nearly equal thickness, situated under a mass of new red sandstone, of variable thickness, which lay unconformably upon it. The seams cut being apparently similar and at nearly equal depths, it was natural to suppose them to, be the same, and to lie as indicated by the dotted lines CD, but subsequent sinking showed that this conclusion was erroneous.—GEO. BROWN. Butterknowle, Darlington.

*Commended.*—S. Chadwick, W. P. Lawes, A. H. Meakin, W. H. Hardy.

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### ADVANCED.

*Question* 4.—Of what is dynamite made, and how is it used?

*Answer.*—As nitro-glycerine is a liquid explosive of great power it cannot be used in mining in this form as it cannot be handled, and if let fall it will explode with great violence. A small amount of this taken into the human system will prove fatal in a short time. Owing to the above causes it is mixed with a kind of earth known as kiesulguhr, found in Hanover. It is composed of minute shells, and absorbs the nitro-glycerine and makes it safe for handling, storage, etc., whilst its power as an explosive is not diminished. It is composed of 75 per cent. nitro-glycerine, and 25 per cent. kiesulguhr (unctious earth). It is of a pale reddish colour, is of a plastic nature, and is wrapped up in parchment paper cartridges four to seven inches long. If struck, it may explode. Dynamite freezes sooner than water, and when in this state there is danger in thawing it. For this reason it should be kept dry and warm to keep it from freezing. Gunpowder has a blasting power of one, that of dynamite being seven times stronger, and it has a tendency to strike downwards. To explode it, fuse and detonators filled with fulminate of mercury, or other strong explosive, are used to give to the charge a sudden shock. Sometimes electric batteries and cables are used, especially for sinking pits, where the charge can be fired from the bank. When the charge has been placed in the hole a primer (small cartridge) is placed on the top, with the fuse pinched into a hole made with a small pointed stick. The paper is tied with a piece of string round the top of the primer, and then tamped in the usual way. Dynamite can be used in water which makes excellent stemming.—JOHN COOK, 28, Smithey Green, Smithies, Barnsley.

*Commended.*—T. P. Callaghan, G. A. Hawes, H. Talbot, J. Burrows, S. Davies.

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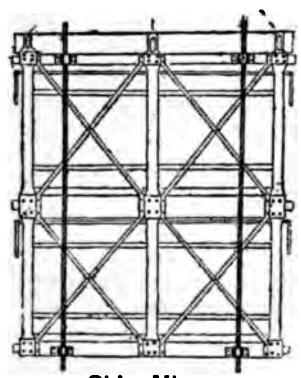
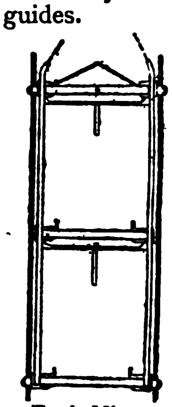
*Question* 5.—Describe, with sketches, a double-deck cage, and describe clearly the method of attaching wire rope guides.



Side View.



End View.

*Answer.*—Figs. 1 and 2 illustrate a side and end view of a double-decked drawing cage to hold four corves, two in each deck. They are made of wrought iron and steel, and attached to the drawing rope by six chains, and when four guides are used for each cage the shoes or slides are fixed near the corners. The top deck or upper chamber is used for drawing men and horses as well as corves, and for this reason it is made about one foot six inches higher. Its height is often five feet six inches and the lower one four feet, the width being made according to the size of the corf and the size of the shaft. They are made of diagonal bars, sometimes with sheet-iron at the sides,

and roof of the same material to keep things from falling into the cage as it goes up and down the shaft.—C.M.R.A. In the roof of each cage are hinged doors which are opened to send long timber, rails, pipes, etc. down the pit. The system of attaching wire rope guides in a shaft is as follows:—They should be put in to give as much clearance as possible when drawing at great speed, as there is always a large amount of oscillation of the cages. The number of guides used is sometimes two, three, or four. They are passed through strong baulks of timber near to the pulleys, and made fast by wrought-iron clams. They then pass down the shaft, the loose end passing through strong baulks of timber below the level of the seam (in the sump). The rope-end is then turned up and capped, similar to a drawing rope. On the capple are hung heavy weights to keep a constant strain upon the rope, and by this means keep the rope rigid and straight. Room should be left for the weights to rise or fall as the rope expands or contracts, according to the variations of temperature. Two independent ropes are sometimes put down the centre of the shaft to keep the cages from catching.—JOHN COOK, 28, Smithey Green, Smithies, Barnsley.

*Commended.*—S. Davis, G. Daykin.

*Question* 6.—Give a description of the Forest of Dean coalfield.

*Answer.*—This coalfield is only a small one (compared with the other coalfields in the British Isles) which covers a portion of Gloucestershire, and forms one of the most perfect coal basins in England. The different seams everywhere are dipping on all sides towards the centre, and are bounded or skirted by its base rocks the carboniferous mountain limestone on which they rest. The area is about 34 square miles in extent, and from its regularity, is thoroughly known, even where it is yet unproved or worked by shafts. It contains fifteen different seams of coal, but there are only about eight or ten which are at present workable. There are more thin seams interstratified in this coalfield than any other known. They amount to thirteen in number, having an average thickness of from 8 inches to 2 feet 9 inches. The lower seams vary from 1 foot 6 inches to 4 feet 6 inches thick. The latter gives a total thickness of coal from 24 to 27 feet, and the general thickness of the coal measures are about 2400 feet. Below the Churchway Delf seam and above the noted Coleford High Delf seam there occurs a thick series of sandstone strata, thus giving rise to numerous excellent quarries, and which, in some degree, appear to be equivalent to the Pennont quarries of the Bristol coalfield. But the most remarkable incident connected with the Coleford High Delf seam is the depression, which is commonly called the "horse," which traverses this bed of coal. The "horse" with its connecting branches appears to have been once the bed or seat of a river which formerly cut its way through the vegetable formed matter when in a state of decomposition, and thus in a soft tender condition. The cutting or channel thus made was afterwards filled up, layer upon layer, with sand, stone, and other deposits. These interruptions in this Coleford seam are a considerable loss to all the colliery proprietors. It is nearly two miles in length, and varies from 170 to 350 yards in breadth. The following is the general order of the successive seams and strata:—

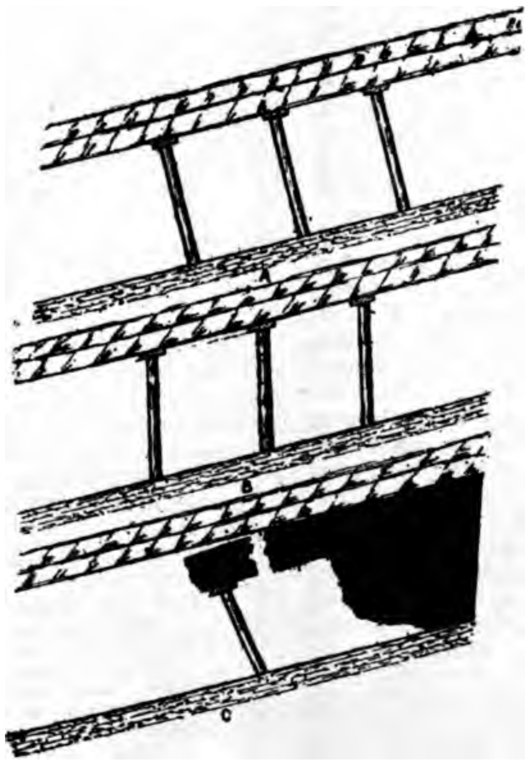
| | Ft. | Ins. | |
|---|---|---|---|
| Sandstone and shale cover (centre of basin).. .. .. .. .. .. | 830 | 0 | thick |
| 1 Cow Delph seam .. .. .. .. .. | 0 | 8 | ,, |
| Strata .. .. .. .. .. .. .. .. | 90 | 10 | ,, |
| 2 Dog Delf .. .. .. .. .. .. .. .. | 0 | 2 | ,, |
| Strata .. .. .. .. .. .. .. .. | 46 | 9 | ,, |
| 3 Smith Coal.. .. .. .. .. .. .. .. | 2 | 6 | ,, |
| Strata .. .. .. .. .. .. .. .. | 34 | 6 | ,, |
| 4 Little Delf .. .. .. .. .. .. .. .. | 1 | 8 | ,, |
| Strata .. .. .. .. .. .. .. .. | 48 | 8 | ,, |
| 5 Park End High Delf .. .. .. .. | 3 | 4 | ,, |
| Strata .. .. .. .. .. .. .. .. | 56 | 0 | ,, |
| 6 Starkey Delf .. .. .. .. .. .. .. | 2 | 0 | ,, |
| Strata .. .. .. .. .. .. .. .. | 50 | 0 | ,, |
| 7 Rocky Delf.. .. .. .. .. .. .. .. | 1 | 9 | ,, |
| Strata .. .. .. .. .. .. .. .. | 77 | 6 | ,, |
| 8 Upper Churchway Delf .. .. .. .. | 1 | 11 | ,, |
| Strata .. .. .. .. .. .. .. .. | 34 | 0 | ,, |
| 9 Lower Churchway Delf .. .. .. .. | 1 | 6 | ,, |
| Strata .. .. .. .. .. .. .. .. | 150 | 0 | ,, |
| 10 Braizley Delf .. .. .. .. .. .. | 1 | 9 | ,, |
| Strata .. .. .. .. .. .. .. .. | 430 | 0 | ,, |
| 11 Yorkley Delf .. .. .. .. .. .. | 2 | 9 | ,, |
| Strata .. .. .. .. .. .. .. .. | 153 | 0 | ,, |
| 12 Whittington Delf .. .. .. .. .. | 2 | 6 | ,, |
| Strata .. .. .. .. .. .. .. .. | 137 | 0 | ,, |
| 13 Coleford High Delf .. .. .. .. .. | 5 | 0 | ,, |
| Strata .. .. .. .. .. .. .. .. | 124 | 0 | ,, |
| 14 Upper Trencherd Delf .. .. .. | 2 | 0 | ,, |
| Strata .. .. .. .. .. .. .. .. | 72 | 0 | ,, |
| 15 Lower Trencherd or Bottom Seam | 1 | 4 | ,, |

The collieries are principally worked from the margin of the basin where the seams crop out towards the centre. This field contains several iron ore beds of excellent quality.—SAMUEL DAVIES, Park Road View, Worsbro' Bridge, near Barnsley.

*Commended.*—G. A. Hawes, Hy. Talbot, J. Burrows.

**FIRST-CLASS**

*Question* 7.—How do you arrive at the proper angle supporting timber should be fixed in mines of steep inclination? Give illustrative sketches.



*Answer.*—The weight of the strata acts at right angles to the inclination. Therefore, for props set at the face, their direction should be at right angles to the roof and floor (sketch A) as their use is generally to steady the roof and not to carry it, except when it is broken behind, when that part of the roof which they are supporting has a tendency to move in two directions, viz., to fall perpendicularly, and to move along towards the dip. The proper angle would be that made by the direction of the resultant of these two forces, if they were known, as, if the prop be set at that angle, the full pressure would be acting directly on it to compress it, so that under these conditions the prop would have to be fixed a little more than at right angles (sketch B) as, when the weight came on, it would tend to force the prop tighter; otherwise, if set at right angles, the broken stone would throw the prop as it were. (Sketch C.) But, in the former case, the bottom will not be well founded, and the pressure will be unequally distributed. Therefore the direction in which a stone falls would just be as efficacious as at right angles, provided we cut a seat in the floor for the prop, and have special wedges like headtrees or crowns for the purpose, but not otherwise. From the above statements timber should be set, in all cases, in a direct line to the pressure exerted, as well as on a sure foundation.—JOHN McPHAIL, 6, Sourlie Irvine, Ayrshire.

*Commended.*—J. Wallwork, J. Smith, G. W. Scougall.

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*Question* 8.—Under what circumstances would you adopt the longwall method of working?

*Answer.*—The longwall method of working coal is often very successful where the thill or floor is sufficiently strong to bear the crushing force of the pack walls. It has been found to be very successful in the North of England for seams of four feet and under in thickness. A seam under five feet with a roof of strong blue shale is best worked by longwall, especially if the floor be hard and the seam contain bands, as a roof like this would probably fall and break off behind the timber and thus relieve the pressure on the coal and gateways, whereas

a strong post roof often breaks over the timber right up to the face, and even goes on to the coal, settling down and nipping it. The following are the general conditions upon which the longwall system is adopted:—A seam free from troubles or faults, a thin seam, a seam with a dirt parting, and a seam of ironstone working with the coal. In longwall working all the coal is worked away at once, leaving no pillars. The advantages of the longwall system are that 14 per cent. more large coal is abtained than in pillar and stall, and 15 to 25 per cent. more coal per acre. The system is simple, the ventilation easy, and the men work with greater safety. In the system of longwall working the proper position of the wall face depends chiefly upon the inclination of the seam. If the inclination is moderate, the wall face should be at right angles to the dip of the seam. In this case the roads are easier to maintain. If the dip of the seam is considerable it is advisable to have the wall face parallel to the direction of the dip, and in this case the coal will be chiefly transported by cross-cuts worked, perhaps, as self-acting inclines. With a crushing roof the wall face should, if possible, be at right angles to the cleat; with a strong seam the wall face should be parallel to the cleat. A seam with a good strong floor but a tender roof difficult to support is best worked by the hip and caunch or "step" method of longwall.—F. KING, Cramlington Colliery. Northumberland.

*Commended.*—J. Smith, J. Wallwork, G. W. Scougall, T. Banks, B. Nightingale, J. Graham..

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*Question* 9.—What is the advantage of noticing the changes of the barometer at a colliery.?

*Answer.*—To understand the advantage of having the barometer placed at a colliery, as required by the C.M.R.A., section 42, general rule 33, we must first understand its use and the principle involved in its construction. The common barometer consists of a glass tube about three feet long, closed at the top, and containing a column of mercury. The top part of the tube is a vacuum, so the top of the mercury is not subjected to any pressure, but the bottom end is subjected to the pressure of the atmosphere. Hence the height of the mercury column is a measure of the atmospheric pressure. A scale is attached for reading the height, which, at sea level, averages about 30 inches. Its use in mining is that it shows the changes which occur in the pressure of the atmosphere, the variations of the atmospheric pressure having a considerable effect upon the quantity of carburetted hydrogen and carbon dioxide issuing into the mine from the floors, breaks, or joints in the ground, and from old goaves and other vacant places. The reason of this may be very easily understood by observing BOYLE'S law, viz.:—"The volume varies inversely as the pressure." For an example, suppose there are 2,000 cubic feet pent up in the old goaves and other places, when the barometer is standing at 29·5. How much would the volume increase if the barometer fell to 28 inches.

$$\frac{2000 \times 29{\cdot}5}{28} = \underline{\underline{2{,}107 \text{ Cubic feet.}}}$$

Hence we find the volume of gas increased by 107 cubic feet, thus increasing the danger of an explosion unless strict precautions are taken. The most important use of the barometer is that it gives warning to those concerned when an extra inflow of gas may be expected. It may also be used to find the approximate depth of any mine, as the reading increases one inch for about every 900 feet we we descend.—MYLES BROWN, Butterknowle, Darlington.

*Commended.*—J. Taylor, T. Rushton, T. Banks, G. W. Scougall, J. Graham, J. McPhail, F. King,

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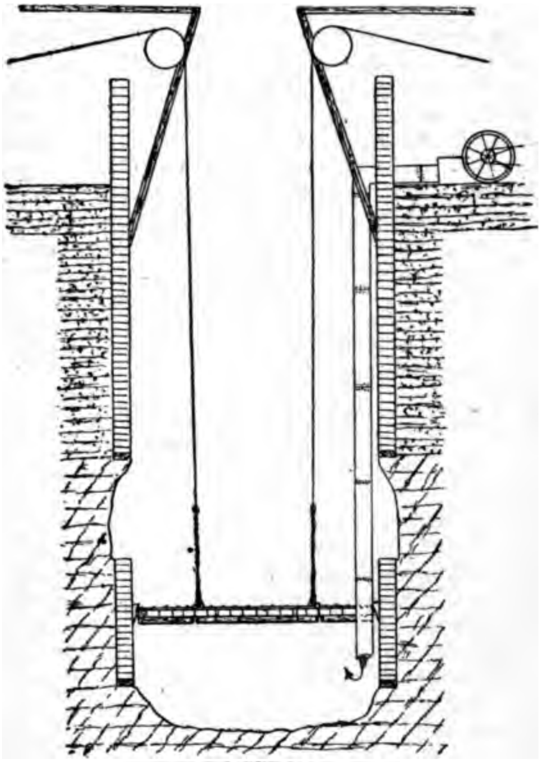
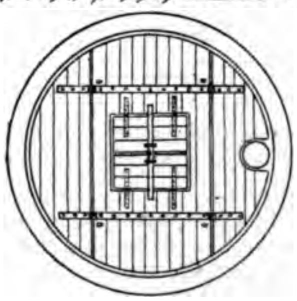
*Question* 10.—Give sketch and description of the ordinary bricking scaffold used in sinking pits.

*Answer.*—The accompanying sketch shows the plan and section of an ordinary bricking scaffold, and also the manner in which it is suspended in the shaft. It usually consists of deal planks, three inches thick, jointed together and fastened to transverse planks. It is made about six inches less in diameter than the finished size of the shaft, and is made into three portions, which are hinged together to enable it to be folded up when putting in or taking out of the shaft. I have presumed that the ventilation is produced by a small fan and air pipes, when it will be necessary to cut a hole in the scaffold for the air pipes. It is suspended from the surface by two wire ropes which pass over pulleys at the top to two crab engines fixed in a convenient position on each side of the shaft. The scaffold is connected to the ropes by four bridle chains—two to each rope—and is raised and lowered by the two crabs as required, the scaffold being steadied for the bricking by pushing seven or





eight short iron bars into the wall, at intervals round its circumference. A trap-door is let in the centre of the scaffold to allow the hoppet to clear out the water from the bottom.
JOHN MCPHAIL, 6, Sourlie Irvine, Ayrshire.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

GREATEST DEPTH TO WHICH MINES CAN BE WORKED.

Sir,—I should like to hear the opinion of some of your readers with reference to the greatest depth to which coal can be worked. If I am not mistaken, a selected committee have agreed upon the depth to be 4,000 feet, but since this decision was arrived at many changes have occurred which would perhaps alter it. One authority, at least has declared that this depth is far too little, and that mines can be worked much below it. Your readers' opinion will oblige

"DEEP MINE."

SAFETY LAMPS.

Sir,—Would you kindly let me know, through the correspondence column of your next issue of "Mining" "Why is a safety lamp considered safe." A reply in your next issue will greatly oblige, as I am badly in need of the information. "LOTTYN."

## EDITORIAL CHAT.

WE have no doubt that a large number of our readers presented themselves for the Science and Art Department's Examination in the Principles of Mining, held on the 8th ult., and we wish them every success. Our readers should be especially fortunate for we have, during the past few months, by judicious choosing, given in our Competition Questions many of those which were asked at the Examination.

The Elementary Questions were somewhat similar to those of previous years, and we have published sufficient Questions and Answers in the few issues of our Journal preceding the Examination to enable the diligent reader to come up successfully, even if his advent into mining matters dates only a few months back.

In our opinion, the Advanced paper was comparatively the most difficult, insomuch that many of the questions were unusual, and were such as a second-year student could hardly be expected to know.

The Honour's Examinations in previous years have excited considerable comment and displeasure to the coal-mining student, and it appeared to be of no avail, but this year's questions were more suitable than any previously given. Six questions were purely "coal mining," and, as it was only necessary to answer six, the candidate had a fair opportunity of answering the paper properly. Some of the questions appeared to be extremely simple, and we are afraid that many candidates who should have taken the Advanced will have been misled by them, and induced to take the Honours. Now, although such questions as "Describe a system of haulage," or "the longwall method of working" could be answered in a general manner by even the Elementary Student, yet they give scope for detail answering, such as none but an advanced student could do. Nevertheless we anticipate a larger percentage of passes in this stage this year than has usually been the case, and can only hope that the readers of "Mining" will be well represented.

We should like to offer a little advice to students for the next year, and a glance at our past issues will prove that it will be efficacious. Let the student join the list of our Competitors at once, and endeavour to answer the whole of the questions in the grade for which he is desirous of sitting, during the next year, and we can unhesitatingly promise him that he will not be amongst the number "plucked."—THE EDITOR.

*Printed* and Published by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.


o 15. Vol. II. SATURDAY, JUNE 16, 1894. FORTNIGHTLY. ONE PENNY.


## CONTENTS.



# EASY LESSONS ON MINE SURVEYING

**For Beginners.**

*Commenced in No. 2, Volume II.*

### MEASUREMENTS.—(Contd.)

HEIGHTS AND DISTANCES.

EXAMPLE.—To find the distance between the two points A and B (Fig. 57) which are inaccessible from one to the other by reason of the intervening water.

(1) WITH AN ANGLING INSTRUMENT.—Place a dial or theodolite at the point C, from whence both stations can be seen. Ascertain the angle ACB, and measure the two lines AC and CB. The distance can then be found by trigonometry,* or by plotting the angle on paper, marking off the two sides to scale equal to their respective lengths, and measuring the required distance with the scale.

(2) WITH THE CHAIN ALONE.—Measure AC and BC and produce the lines to E and D, making CE equal to AC, and CD equal to BC. Then, the distance DE being measured will give the required distance between A and B. For the angle DCE is equal to the angle ACB, and the sides CD and CE are each equal to CB and AB respectively; therefore the two triangles ACB and DCE are equal in every respect, and DE equals AB.

Possibly some obstruction would not allow of the lines AC and BC being produced to D and E, when it would be sufficient to produce the lines on to, say, *a* and *b*. Then when the lines C*a*, C*b*, and *ab* were measured, together with the original lines AC and CB, by plotting them, the distance between A and B could be found. This method is not, however, so accurate as the one previously mentioned, as the further the lines are produced the more accurate is the work.

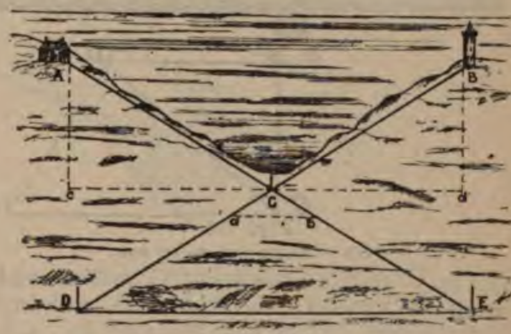



Fig. 57.

(3) WITH THE CROSS-STAFF.—This instrument is used by surveyors for laying down lines at right angles to each other. A simple form can be made by taking a three-quarter-inch piece of wood, six inches square, and by cutting two grooves along its diagonals two

* Solutions of triangles which can be effected by trigonometry can also be ascertained by plotting on paper, and, in fact, trigonometry is most often used for checking the survey after it is plotted. The writer does not intend to treat with the subject of trigonometry in these Elementary Lessons, so will refer the student to plotting when required.

lines are formed at right angles to each other, which may be used as sights. This is fastened to a staff with a pointed end so that it can be pushed into the ground with the sights in any required position. To lay down a line at right angles to another the eye sights along one of the grooves and fixes the staff so that the groove is in line with the original base line. Then, by looking along the other groove a line can be staffed out at right angles to the first.

To return to the example in question:—By means of the cross-staff lay down two lines A*c* and B*d* at right angles to AB, and make A*c* equal to B*d*. Then, if the distance *cd* be measured, it will be equal to AB, the required distance.

As to which of the above methods should be used is a question which would depend upon the ability of the surveyor, and to what degree of accuracy the work is required. In the succeeding problems only one method will be described for each, as the student will be able to determine for himself what other methods may be applicable.

EXAMPLE.—To find the distance between two objects A and B (Fig. 58), one on each side of a river without crossing it.

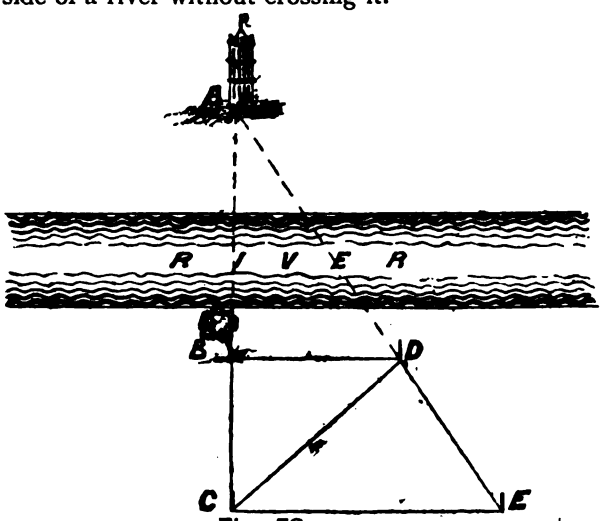



Fig. 58.
Scale:—Ninety feet to an inch.

Fix a staff at the point C in line with A and B, another at any point D, and staff out the line AD to E. Measure BC, CE, ED, DB, and CD. Then, by plotting the two triangles CBD and CED in their correct position to scale, the position of A will be fixed on the paper by producing CB and ED until they meet. The distance between A and B can then be measured.

In the above example it would be well to measure BE to serve as a check on the work.

The measurements according to the scale are BD 79, BC 71, CD 105, DE 87, and CE 127. These measurements are plotted in the following manner:—Draw a line on the paper and mark it off with the scale equal to CD, *i.e.*, 105 feet; now with the other two measurements, BC 71 and BD 79, a triangle can be formed with the compass as described previously. On the other side of DD plot the other measurements DE and CE in the same manner, then when CB and ED are produced to meet, the point A where they meet will be 117 feet from the point B.

*(To be Continued.)*

## COMPETITION QUESTIONS.

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2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3.—Correct name and postal address must be sent.

4.—They must reach us by June 23rd, 1894.

5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—What circumstances are to be considered in determining the length of the stalls in long-wall working?

*Question* 2.—How is a mine upon a lode laid out for working?

*Question* 3.—Define the terms fault, throw, hitch, and heave, as used by miners.

### ADVANCED.

*Question* 4.—Describe NIXON's ventilating machine.

*Question* 5.—What is cannel coal, and under what conditions is it generally found?

*Question* 6.—Describe, with illustrations, the operations of getting coal in a longwall working

FIRST-CLASS.

*Question* 7.—How would you arrange the pit bottom of a mine, the output of which is expected to be large?

*Question* 8.—What rules would you enforce in a mine, with reference to timbering?

*Question* 9.—You are required to put two cages, three tubs in a deck, in a shaft which originally was intended for cages with two tubs in a deck, and is, in consequence, very small for the size of the cages. How would you arrange the guide rods (wire rope) to prevent the cages colliding?

*Question* 10.—What is spontaneous combustion or gob-fires in a mine? How are they produced? Give a sketch of a gob-fire in the workings, and state how you would deal with it.

# BLASTING:

INSTRUCTIONS FOR USING DYNAMITE, BLASTING GELATINE, AND GELATINE DYNAMITE, AS SUPPLIED BY MESSRS. NOBEL & Co., LIMITED, EXPLOSIVE MANUFACTURERS.

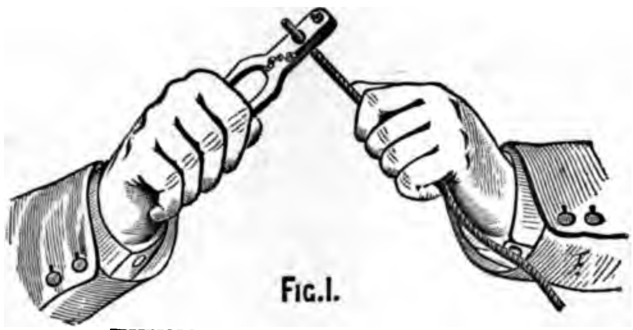


FIG. I.

**FIXING DETONATOR ON FUSE.**

UNLIKE Gunpowder, Dynamite, Blasting Gelatine and Gelatine Dynamite require a special mode of firing, which consists of a very strong percussion cap called a detonator, attached to a safety or electric fuse. The fuse explodes the fulminate, which then explodes the cartridge. A charge is made as follows:—

N.B.—For use under water, great care should be taken to have the upper end of the detonator made water-tight, with grease, tar, or otherwise, where it joins the fuse, to prevent the fulminate from getting damp.

*Second Operation.*—A primer or cartridge is opened at one end, and the detonator, with the fuse already attached to it, is pushed in

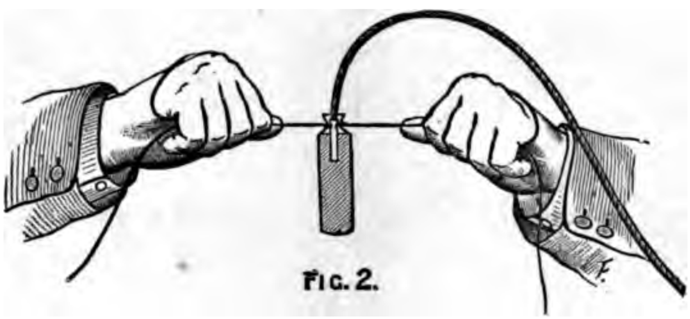
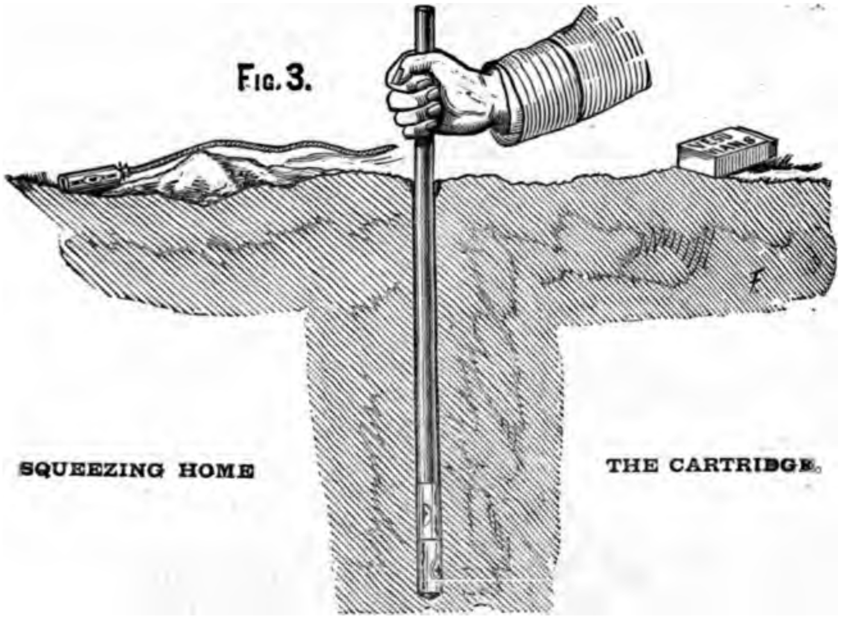


FIG. 2.

**FIXING DETONATOR (WITH FUSE ATTACHED) INTO CARTRIDGE OR PRIMER.**

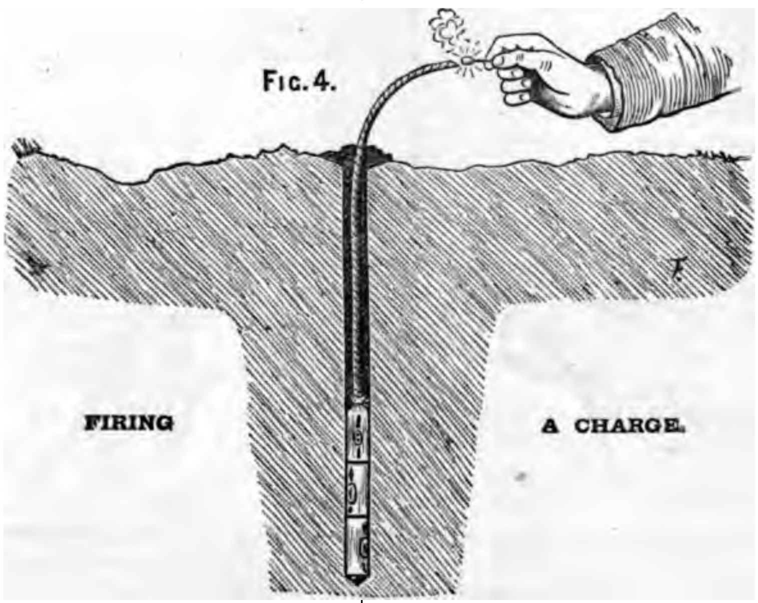
*First Operation.*—A safety fuse is cut clean, and inserted into a detonator, till it reaches the fulminate. The upper part of the cap is then squeezed with a pair of nippers (as shown in Figure 1). The squeezing should not be neglected, as it not only secures the position of the fuse, but also serves to develop the power of the fulminate.

so as to leave about one-third of the copper tube exposed outside the cartridge. The detonator is then securely tied in that position. If the detonator is pushed too far into the cartridge, the fuse may set fire to the latter before the spark can explode the detonator, and unpleasant fumes may be the consequence.




*Third Operation.*—One or more cartridges, as the height of charge may require, are inserted into the borehole, and each squeezed with a wooden rammer (as shewn in Fig. 3) so as to completely fill out the bore-hole. Never use iron in squeezing home cartridges.

*Fourth Operation.*—Over the charge, as shown in third operation, the cartridge, with detonator and fuse affixed, is inserted, but not squeezed, and loose sand or water is poured in as tamping (as shown in Fig. 4). The charge is then ready for firing.




INSTRUCTIONS FOR CHARGING BORE-HOLES.

1.—A wooden rod or squeezer should be used to push home the cartridges in the bore-hole. Never use a metal rod or rammer.

2.—Never ram or pound the charge home. It should be gently, although firmly, squeezed into its place.

3.—Never squeeze the primer containing the detonator, but lower or push it gently until it rests on the charge.

4.—Use sand or water tamping.

5.—In the event of a miss-fire never attempt to draw the tamping. If water tamping has been used put a fresh primer and detonator into the hole on the top of the charge. The explosion of the primer will set off the whole charge.

6.—If other than water tamping has been used make a fresh bore-hole; but care must be taken to make it at a safe distance from the former hole, and in such a position or direction that the boring-tool cannot come in contact with explosive in, or escaping from, the hole that has missed fire.

7.—In all cases after a blast the material brought down or blown out ought to be carefully examined, lest any cartridges or pieces of cartridge remain unexploded.

8.—In charging wet holes be careful to ascertain that the cartridges are squeezed well home and that they rest on each other.

9.—If the cartridges are not pressed well down water may come between them and prevent the explosion of the primer, or cartridge containing the detonator, from communicating to the other cartridges.

10.—In such a case when the primer is exploded the operator may be deceived by the sound, and think that the charge has completely exploded, whereas the layer of water may have prevented the transmission of explosion throughout.

11.—If the hole is not then carefully examined some dynamite may remain in it and prove a source of accident in boring the next hole.

12.—All holes that appear insufficiently blasted must be carefully searched with a wooden rod to ascertain whether any dynamite remains in them after the explosion. Accidents have occurred from neglect of this precaution.

13.—All wet holes ought to be blasted as soon as possible after charging.

*We are able to print the above through the courtesy of Messrs. Nobel & Co., Limited, to whom we are also indebted for the illustrations.*

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# CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### SAFETY LAMPS.

Sir.—In answer to LOTTYN'S query of "Why is a safety lamp considered safe" I offer the following, which I hope he will deem sufficient.

A lamp is safe, as the term is applied to mining, when the flame is so isolated as to prevent the ignition of the explosive gas in the mine, the gas not being capable of exploding without the application of a flame. Now, what happens to a safety lamp when placed in an explosive mixture is this:—It ignites the explosive gas which is in the lamp, but the wire gauze conducts the heat away so quickly that the flame cannot pass through it. Or, in the case of more modern lamps, only sufficient air (which is necessary to support combustion) is allowed to have access to the flame to enable it to burn properly, this being effected by making the air passages small, or the course of the current difficult. When the lamp is placed into an explosive mixture there is insufficient air to support the combustion, even of the ordinary flame, but the flame is enlarged by reason of the explosive gas lighting. Therefore, the light dies out, and the lamp is practically safe. T.R.F.

### HOW IS THE VALUE OF A COLLIERY ESTIMATED?

Sir.—I should be obliged if you could give, in your correspondence columns, a general answer to the above question, and oblige, UNDER-MANAGER.

### H.P. OF BOILER.

Sir,—I would be pleased if you would insert the following question in your correspondence page, to be answered by some of your readers:—

An upright boiler of the following dimensions, viz.: Three feet diameter, ten feet high, with sixty pounds pressure per square inch; what would be the horse-power, and show how you would work it out in figures?

A YOUNG ENGINEER.

### RULE TO FIND CONTENTS OF STACK OF CANNEL, &c.

Sir,—Will you please insert the following in your correspondence column:—

What is the rule to find the contents of a Stack of Cannel, it being both round and small; and also will water increase the specific gravity of Cannel by its standing stacked.

A reply from any reader would greatly oblige.

X.Y.Z.

# EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

(*Continued from No. 14, Vol. II.*)

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

## Subject.—

## PRACTICAL MINING.

QUESTION 6.—Name any "high explosive" with the use of which you have had experience. Explain how it is used, and what advantages are claimed for it.

ANSWER.—Dynamite is one of the "high explosives" with which I have had some experience. It is composed of 75 parts, by weight, of nitro-glycerine absorbed in 25 parts, by weight, of kieselguhr. The latter is the mineral remains of a kind of moss which grew in stagnant waters. The stem consisted chiefly of silica, and when the organic substance of the plant decayed the silicious portion remained, retaining the shape it had when it formed a part of the plant, that is, a series of cells. Beds of kieselguhr are found in many parts of Germany, and also in this country, where they form the bottoms of peat mosses.

The chief advantages claimed for it are:—(*a*) Great saving of labour, smaller and fewer boreholes being sufficient. (*b*) Saving of tools, (*c*) Avoidance of tamping, as loose sand or water is sufficient. (*d*) Freedom from accident in stemming. (*e*) Facility in blasting in wet holes and under water. (*f*) Absence of smoke. (*g*) For sinking shafts and driving tunnels this explosive is very efficient. (*h*) When the instructions for use are followed accidents are unknown.

(*See Article in this issue on Blasting.*)

QUESTION 7.—Make sketches, in ink of a colliery tram, tub, or corve, giving its principal dimensions, its weight and cost, and state the weight of coal it is designed to carry.

ANSWER.—The following are the dimensions of a colliery tub which is designed to carry 6 cwts. of coal:—Weight of tubs, 2·5 cwt.; wheels, 8 inches diameter. Inside measurements are:—Length, 39 inches; depth, 16 inches; width, 34 inches.

(*Sketches in No. 1, Vol. II.*)

QUESTION 8.—If you required a very accurate measurement of the air passing through an underground roadway, what plan would yon adopt for arriving at the mean velocity?

ANSWER.—In order to obtain accurate results in the measurement of ventilation the anemometer should be at arm's length in front of the body and moved slowly and uniformly over the whole area of the air-way, from a point of the floor to a point of the roof, because there is a different velocity of air in various positions of the sectional area. When the most accurate results are required, the best method is to fix a number of fine wires or strings, at right angles to each other, from side to side and from roof to roof, and at regular distances apart, so as to divide the air-way into a number of equal divisions. The number of revolutions of the anemometer must be noted during two or three minutes in each division, and the mean result taken. The operation should be repeated when great accuracy is required, and if the mean results differ the whole operation should be gone through again.

QUESTION 9.—What are the various causes of accidents by falls of roof in stalls or working faces?

ANSWER.—Accidents by falls of roof and sides are sometimes caused by slips and pot-holes in the roof which, at times, are difficult to detect—even the keenest observers may not be able to detect them—and others are caused by the neglect of timbering. The workmen, at times, put far too much confidence in the nature of the roof, thereby delaying too long before setting timber, and running a far greater risk of accident than would be the case if a thorough systematic method of timbering was enforced. If this was done, I have no doubt accidents from this source would be considerably diminished.

(*To be continued.*)

## RECENT IMPROVEMENTS
IN
# MINING MACHINERY & APPLIANCES
BY
MR. WM. SAINT, H.M.I.M.

(Address read before the Manchester Geological Society.)

*Continued from last issue.*

### WINDING ENGINES & WINDING.

Considerable progress has been made in the construction of winding engines, and some fine examples are working in this district. They are usually of the horizontal type, and have two cylinders with the drum on the crank shaft between them. Several of the larger engines are fitted with automatic expansion gear, which comes into action when the maximum speed is attained. Twin compound winding engines with steam reversing gear, parallel drums, balance ropes, and separate condensers have been recently introduced into Wales and Lancashire. In the former they have been working more than a year, and are pronounced an unqualified success; but the one in Lancashire has not yet been practically tested. These engines are fitted with automatic expansion gear to the high pressure cylinder. The cylinders are connected by a large steam pipe, which answers the purpose of a receiver, to which is attached a relief valve to prevent excessive pressure reaching the low-pressure cylinder, and an auxiliary valve to admit live steam to the low-pressure cylinder, or relieve the back pressure on the high-pressure cylinder at the discretion of the engine driver.

Steam brakes are now considered a necessity for use in case of emergency, a foot brake being used in ordinary working. In some instances the winding engines exhaust into a separate condenser, but this arrangement is not so generally adopted as it might be.

In connection with a few of our winding engines there are devices for preventing overwinding which come into action and automatically shut off the steam and apply the steam brake on the cage reaching a certain position above the surface landing, and the cage is simultaneously secured against falling down the shaft. Detaching hooks between the ropes and the cages are extensively employed. Safety cages are quite common in Lancashire collieries, where the shafts are fitted with wooden conductors.

Improved winding ropes, guide ropes, and methods of capping have been introduced.

Balance ropes beneath the cages are employed in many pits. They insure greater uniformity of the speed in the shaft. The cages run more steadily and the engineman is enabled to control the load. Although there is little apparent saving in time of winding by their use their advantages in other respects should ensure their more general adoption.

### FAN ENGINES AND FANS.

Fan engines being constantly running are in many instances carefully designed with a view to economy in the consumption of steam. Twin compound engines with automatic expansion gear and separate condenser being perhaps the most approved form. The best designed engines are substantial in construction and the stuffing boxes are fitted with "floating" metallic packing. The bearing surfaces are large to minimise the chances of heating, and each bearing receives a copious supply of oil from a sight-feed lubricator. The waste oil is collected, filtered, and used repeatedly. Mr. Henry Hall's automatic recording water guage and speed indicator is a useful addition.

Fans for ventilating mines have been extensively introduced in recent years, and they are rapidly displacing furnaces, the disadvantages of which are many. It is no longer a question as to the relative merits of furnaces and fans, but rather a rivalry of fans. Higher water guages and greater volumes of air than furnaces can produce economically are required to meet the exigencies of the times. But it must be a rare case indeed where a modern fan cannot be made to do equal work with considerably less consumption of fuel than a furnace. The most approved fans for obtaining high water guages are of the close running type, very substantially made, and are driven by belt or rope gearing. They are built almost entirely of steel, are comparatively small in diameter, and are able to stand running at high periphery speeds for long periods without danger of breakdown.

Some makers attach great importance to the curvature number or arrangement of their vanes, but it seems probable that the efficiency of a fan depends, in a large measure, upon its capacity being adapted to the mine it is intended to ventilate. It is obvious that a wide fan upon a mine which can only pass a small volume of air, and a narrow fan on a mine which can pass a large volume would show low efficiences, because of the loss of power due to the resistance of the vanes in the one and to the friction of the air in passing through the other. Yet such cases exist at the present time.

(*To be continued.*)

## ANSWERS TO QUESTIONS.

**In No. 13, Vol. 2.**

### ELEMENTARY.

*Question* 1.—Define the terms dip, strike, cleavage, and plane of bedding.

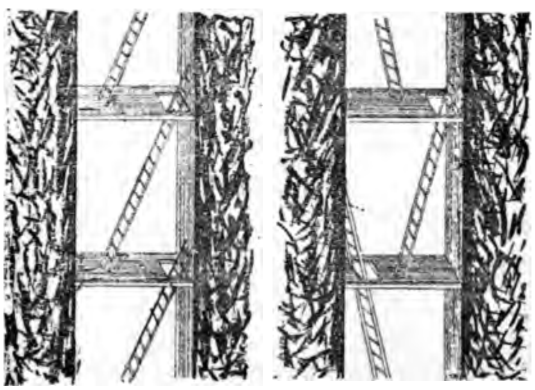
*Answer.*—DIP.—The amount of slope of a bed, seam or vein, measured from a horizontal line.

STRIKE.—The direction of the outcrop of a bed of rock in a level country, or a line at right angles to the dip, sometimes termed its band edge.

CLEAVAGE.—A fissile structure which many rocks and minerals possess of splitting more easily in one direction than in others. Rocks deposited in a plastic condition are cut up by planes of cleavage, due to lateral or side pressure, and the planes of cleavage are generally nearly at right angles to the planes of stratification. Ordinary roofing slate is a good example, for it has a distinct cleavage, and is easily split into thin plates.

PLANE OF BEDDING express a surface of a bed of rock which is the same shape on both sides of the bed, or it may be otherwise regarded as a surface which divides matter. Thus the plane of bedding may be said to have extension but no thickness, and, in some instances, slate rocks have been so altered that the planes of bedding have become obliterated.—JAMES BURROWS, 103, Chapel Street, Dalton-in-Furness.

*Question* 2.—Describe, with sketch, how ladders are fixed in the shaft of a metal mine.



*Answer.*—In metal mines the form of shaft is usually rectangular or oblong, and is divided into three parts, the central part being generally used for the ladder-way. The winding part is securely fenced off with casing boards, which are nailed on to the dividings. The pump end of the shaft is generally left open to the ladder-way, except for the dividings. The ladders are made from ten to twelve feet long with side pieces about two inches thick and four inches broad, the rungs being about twelve inches apart, and made of round wrought iron, about one inch in diameter, and let into the sides. Longer bars are put through at the top and bottom and at intervals, and are secured with a cotter or nut, which braces the ladder and keeps it rigid. Sollars or platforms are put in at intervals, in which spaces are left open for man-holes The ladders are joined together in the shaft, and secured with cleats from three to four feet long, about one inch thick, same width as the ladders, which are nailed on. By this means they can be made any length as required. They are generally made in lengths from twenty to thirty feet, and fixed in a slanting position at the most convenient angle, the bottom end resting on the sollar, and the top leaning against the wall plates or sidepieces, and secured with iron staples. The man-holes should be under the ladder, so as to prevent persons from stepping back and falling through the manhole. Trapdoors are sometimes fixed to the man-holes, but they cause much delay in climbing, and are so frequently left open, that they are not generally adopted.—JAMES BURROWS, 103, Chapel Street, Dalton-in-Furness.

*Question* 3.—What are the advantages and disadvantages of vertical and inclined shafts respectively?

*Answer.*—The advantages of vertical shafts are mainly that they give greater ease in sinking to a given depth, and better facilities for winding and pumping arrangements. The disadvantages are, that with inclined lodes which dip or underlie as much as fourteen inches in a fathom from the perpendicular, a large amount of cross-cutting is required to reach the different levels, thus increasing the working expenses, which is of great importance in mining operations. The advantages of inclined or underlie shafts are that they prove the lodes, the depth of the shafts, and, in some instances, the ore raised is sufficient to cover the expense of sinking. A good arrangement would be to have one vertical shaft with several underlie or inclined shafts, which would facilitate the working of an extensive mine.—JAMES BURROWS, 103, Chapel Street, Dalton-in-Furness.

### ADVANCED.

*Question* 4.—Discuss the advantages of furnace and fan ventilation.

*Answer.*—Before mechanical ventilators came into use artificial ventilation was produced mostly by furnaces. Machinery is now extensively used for ventilating, but many old furnaces are still at work, and several large furnaces have been built for new collieries in recent years. The advantages of the furnace, as viewed from a modern standpoint, with all its improved mechanical ventilators, seem almost to be obliterated, but yet some authorities give it preference under certain conditions. The most important item to be considered should be that of the presence of inflammable gas. A mine ventilated by the furnace should be clear of inflammable gas. The shaft should be of sufficient depth to give a long heated column of air—a very important item in furnace ventilation. It may be advantageous to produce a current of air for temporary requirements. They are most effective at the bottom of a deep and dry up-cast. Hence, the efficiency of furnace ventilation will depend upon two things: first, the difference of the temperature of the air in the two shafts; second, the depth of the shaft; because evidently the difference in the total weight of the two columns of air must be affected by the depths of the columns.

The fan ventilator is the safest and most efficient method. It has many advantages over the furnace, namely:—(1) By being placed in a position as required by the C.M.R.A., general rule 3; it is more convenient as regards examination and repairs; also, it affords greater safety to those employed. (2) Fan ventilation is more efficient. At one colliery there were 100,000 cubic feet of air produced by a furnace, whereas by a fan the quantity has been increased to 180,000 cubic feet per minute, in the same shafts, the useful effect also being largely increased. (3) Quantity of air produced by fan is uniform.

Mechanical ventilators cause no danger in the mine, and, as the machine is placed at the surface. it has no injurious effect upon the shaft itself, or anything in the shaft. There is no depreciation to the land in the vicinity, and the amount of ventilation produced, being by mechanical means, can be made absolutely uniform.

Before giving preference to any particular method, it is common-sense to ascertain the conditions under which ventilation is to be produced. Yet, no doubt, fan ventilation can cope with and overcome the difficulties which are represented in ventilating modern coal mines, hence its extensive and almost universal application.—MYLES BROWN, Butterknowle, Darlington.

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*Question* 5.—Describe, with sketch, *Poetsch's* freezing system of sinking shafts through watery strata.

*Answer.*—Shafts have in some places to be sunk through very loose or running ground, such as quicksand, gravel, sand, &c. In such cases the greatest difficulty arises when this kind of ground gives off very large quantities of water. To sink a shaft through such ground *Poetsch's* freezing system has been found to give excellent results. The main feature of this system is the using of an intensely cold liquid, which is required to solidify the surrounding mass of ground by freezing. Intense cold or very low temperature can be produced by mechanical or chemical processes. There are certain substances which remain liquid at a temperature much below 32 degrees F. In *Poetsch's* system a mechanical process is used to bring the liquid to a very low temperature. The usual cooling liquid is a solution of chloride of calcium, with its freezing point about 40 degrees C., that is, 72 degrees F. below the freezing point of water.

The shaft is sunk down in the ordinary way to the top of the soft and watery ground. The sides are then laid back to allow a series of holes to be bored vertically down through the sand and a short distance into the ground beneath. These holes are of course lined with iron tubes, and a smaller tube is lowered down the centre of the larger one (see sketch). The freezing liquid is pumped down the central tube of each hole, and ascends in the annular space between the central tube and the lining tube. A continual circulation is thus kept up until the whole of the watery strata in and near to the shaft is frozen into a hard and solid mass. The sinking is continued through this block of frozen ground by picks, wedges, etc., no blasting being however allowed. The shaft sides are made secure by tubbing or coffering, and the remainder of the shaft is sunk in the ordinary way.

In one instance this solution (chloride of calcium) was cooled to about 25 degrees C. in the refrigerator, and 57 days' continued refrigeration was required to solidify about 100 feet depth of quicksand, lying 15 feet below the surface. It was found that the frozen mass had then a radius of about ten feet from the boreholes. The cost of the freezing (exclusive of sinking and tubbing) was in that case about £60 per yard depth of sand.—MYLES BROWN, Butterknowle, Darlington.

*For Sketch see No. 25, Vol. I.*

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*Question* 6.—Describe, briefly, the ordinary method of boring with rigid rods. Give sketch of surface arrangement.

Fig. 2.

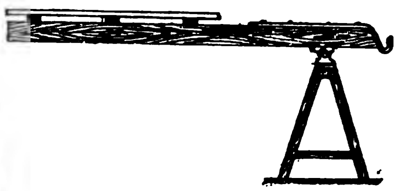

Fig. 1.

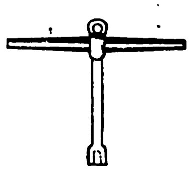

Fig. 3.

*Answer.*—HEADGEAR.—If the borehole is not intended to be a deep one the headgear may consist of three wooden poles erected in a triangular form, meeting at the top, where they are bolted, and where an iron sheave is suspended perpendicularly above the borehole. (See Fig. 1.) For deep holes a contrivance of four wooden poles erected in a square form is generally adopted.

WINDLASS.—This is frequently used for raising the rods in shallow boreholes, and may also be employed to assist the men at the bracehead in the actual process of boring. When the borehole becomes deep, and the windlass incapable of raising the rods, a winch may be applied. In very deep holes a steam winch or some other steam engine is necessary to raise the rods.

ROCKING LEVER.—When the weight of the rods becomes too much for the men at the bracehead, they may be assisted by a rocking-lever. (See Fig. 2.)

BRACEHEAD.—This consists of four wooden arms, about eighteen inches long, at right angles to each other, and firmly secured to a piece of bore rod about eighteen inches long, which is secured to the top of the bore rods when working. (See Fig. 3.)

BORE RODS.—These are generally made of the best iron, of one inch or more square section, in lengths varying from six to eighteen feet. The tools employed in the actual boring of the hole are, viz.:—Chisels, sludgers, augurs, crows-foot, bell, and wadhook. Chisels are employed at the bottom of the borehole, being screwed on to the rods. There is the flat chisel, the V chisel, and the T chisel, which are used according to the nature of the strata. Sludgers are used to clean out the "borings" or debris which accumulates at the bottom of the borehole. Crows-foot, bell, wadhook.—Fractures of the rods cause part of the rods to fall into the bore-hole, in which case some of the foregoing are used to extract broken rods, etc.

PROCESS OF BORING.—The ordinary method of accomplishing this is to use rods of iron called bore rods, attached to the bottom end of which is the cutter or chisel. At the top is a pair of wooden handles called a bracehead, by which the rods are raised and worked in the borehole. To cause the chisel to cut into the rocks two men take hold of the bracehead and raise the rods a few inches, and allow them to drop sharply to the bottom of the hole to force the chisel into the stone. To make the hole as circular as possible, at each time of raising the rods the two men at the bracehead give them a partial turn, in such direction as will prevent any of the rods becoming unscrewed. The holes are cleaned out by means of the sludger. The thickness of each bed of rock is found by marking the rods when a fresh stratum is entered, and the nature of the rock by the contents of the sludger being carefully examined each time.—MYLES BROWN, Butterknowle, Darlington.

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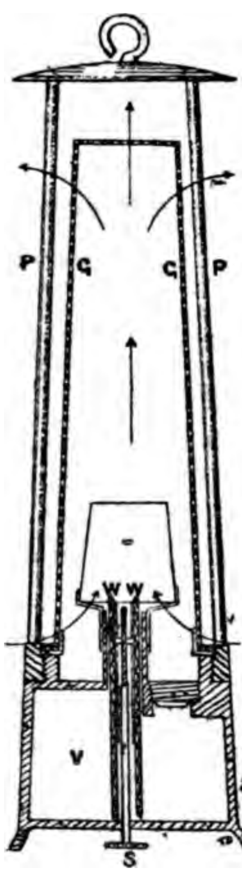
### FIRST-CLASS.

*Question* 7.—Describe, with sketch, the *Pieler* lamp

*Answer.*—The *Pieler* lamp is similar to a *Davy* lamp, and is used solely for testing the quality of the atmosphere of the mine. It consists of the oil vessel (O) in which pure alcohol is burnt, and supplies a round wick (W), made of silk, which passes through a tube. This tube is provided with a small nut inside, and the wick is moved up or down as desired by means of the screw (S). A short conical chimney, open at the top and bottom, is connected around the flame to shield the eye of the man using it. A gauze (G) a little longer than that of the davy is used, and surrounded by pillars (P) to connect the top and bottom of the lamp. The object of the long gauze is to elongate or develop the flame more freely in an explosive mixture. I append the results of experiments made with this lamp.




**Pieler Lamp.**

REFERENCES:—
V—Oil Vessel W—Wick
S—Screw G—Gauze
P—Pillars

A cap with ¼% of fire-damp is of a bluish-grey colour, is slightly luminous, and is 1⅛ inches high. With ½% of fire-damp the cap is 2 inches long, is more clear at the bottom, but fades away at the top. With ¾% of gas the cap is 3 inches, and its colour more blue. With 1% of gas the cap is 3½ inches long, with a deeper blue colour. With 1¼% of gas the cap is 4 inches. With 1½% of gas the cap increases to 4¾ inches. With 1¾% of gas the cap reaches the top of the lamp. With 2% of fire-damp the cap widens out at the top, and, and as the percentage of gas increases, so does the cap increase in size, until it fills the gauze. This is a very sensitive lamp as a gas detector, but its chief disadvantage is that it is easily extinguished in a current of air having a moderate velocity.—G. W. SCOUGALL, Bell's Place, Bedlington, Northumberland.

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*Question* 8.—Having two workable mines within ten yards of each other, how would you work them? What special precautions would you take if both mines were of a fiery character?

*Answer.*—As the two seams are in close proximity to each other, and they are both fiery, great care would have to be exercised to prevent, if possible, the breaking of the strata, and thus allowing the gas to ascend into the upper seam from the lower one. As their thickness is suitable for working longwall, I would adopt that method, commencing the upper seam first. I would drive the winning levels in the direction of the strike, and at intervals of two hundred yards I would set off narrow bords in the direction of the rise. These branch levels could be driven between one hundred and two hundred yards, and then longwall could be opened out on either side of the narrow bords, and worked back towards the shaft. The gateways in narrow work to be ten yards wide and twenty yards long, and to be cut off by cross-gateways. This seam should be kept three hundred yards in advance of the lower one, because if the strata broke a little, the gas from the lower seam would not reach the face of the upper one. This would be one special precaution, together with a brisk ventilating current, and the use of safety lamps in the whole of the mines would be imperative. Duly practical officials to keep strict discipline, flameless powder for shot-firing, and lastly, a through system of packing the goafs would have to be attended to.—G. W. SCOUGALL, Bells' Place, Bedlington, Northumberland.

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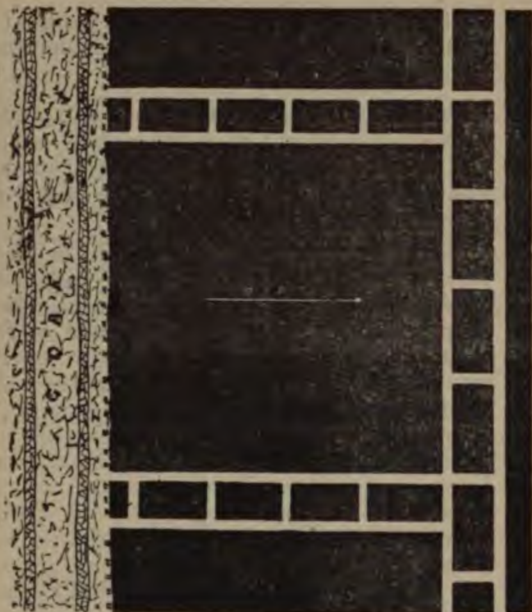
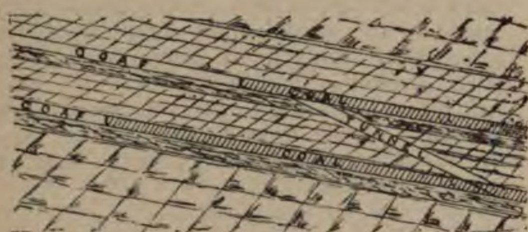
*Question* 9.—Assuming each of the above mines to be three feet six inches thick and the dip of the mine to be one in six, give sketches and describe the arrangements of a portion of the workings.

*Answer.*—The sketch (Fig. 1) shows a portion of the workings of the longwall mode of retreating to the shaft from the boundary. No pack walls are usually required, but sometimes it is expedient to build pack-roads at distances of about fifty yards. By this means the goaf can be ventilated to a certain extent, to prevent the gas from the goaf backing down to the men at the working face when such changes in the pressure of the atmosphere



take place, because gas is held in the goaf by compression, and a sudden lowering of pressure would relieve the gas, and its volume increase. Props and chocks are set to support the roof at the coal face, and, as the face advances, the back ones are withdrawn, and the roof allowed to fall. This method of working is the best, as there would not be such large accumulations of gas as if some



other method was adopted. The face of the working in the top mine should be kept several hundred yards in advance of the mine below, and should be won by tunnels driven from the bottom mine (Fig. 2).—HERBERT HALL, 15, Yardley Row, Ryhill, Wakefield.

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*Question* 10.—What h.p. would be necessary to haul 17 full tubs up an incline of one in five, at a speed of 200 yards per minute, the friction of tubs to be taken as $\frac{1}{28}$ of load.

*Answer.*—The resistance due to gravity and friction of the set multiplied by the speed of *the rope in* feet per minute, and this divided by 33000, multiplied by the modulus of the engine gives the h.p. Thus :—

The weight in each set $= (3\frac{1}{2} + 10\frac{1}{2}) \times 17 \times 112 = 26656$ pounds

The friction of the set $= 26656 \div 28 = 952$ pounds

The gravity of set $= 26656 \times 1 \div 5 = 5331{\cdot}2$ pounds

The speed of the rope $= 200 \times 3 = 600$ feet per minute

Then $5331{\cdot}2 + 952 = 6283{\cdot}2$ pounds total resistance

Then the horse-power $= 163{\cdot}199$

Thus, $\frac{6283{\cdot}2 \times 600}{33000 \times 7} = 163{\cdot}199$ horse-power.

The above is found by assuming the tubs to weigh $3\frac{1}{2}$ cwts. each, to carry a load of $10\frac{1}{2}$ cwts., and 7 for the modulus of the engine, neglecting the weight of rope and friction of the rope and rollers.—ANGUS McLENNAN, 16, Clova Terrace, Uddingston.

## AWARDS

FOR ANSWERS TO ABOVE QUESTIONS.

ELEMENTARY.—James Burrows.
*Commended.*—T. Wilkinson, J. Ferguson, A. Hart, W. Burnett, H. Baddely, W. P. Laws, T. Rowen, J. Coughlin.

ADVANCED.—Myles Brown.
*Commended.*—W. Finley, H. Talbot, S. Thorpe, G. Daykin, C. Priest, T. Welford, T. A. Hawes.

FIRST-CLASS.—G. W. Scougall.
*Commended.*—T. Hooper, J. Worrall, T. Wallet, H. Hall, G. McLellan.

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—The "Mining and Engineering Review" (New York).—Shall be most pleased to exchange publications. The Coolgardie Gold-field, Western Australia, by Albert L Calvert, F.R.G.S., F.G.S.C., etc., price 1s., Messrs. Simpkin, Marshall, Hamilton, Kent & Co., Ltd., publishers. Also T.M., Mining Student, First-Class, and J. Sefton.

COMPETITOR.—The commended names in the Competion Questions are not in the order of merit, but placed indiscriminately. We wish you success.

CERTIFICATED.—Accept our congratulations. Glad to know "Mining" has helped you.

## NOTICE TO SUBSCRIBERS.

In future the cover of our Journal will be white. This will not in any way interfere with the articles, or quantity of matter given. We hope our readers will take notice of this, and continue to help us to get the paper more widely known. From the number of congratulatory letters we receive, it must be appreciated by those who already know the paper.

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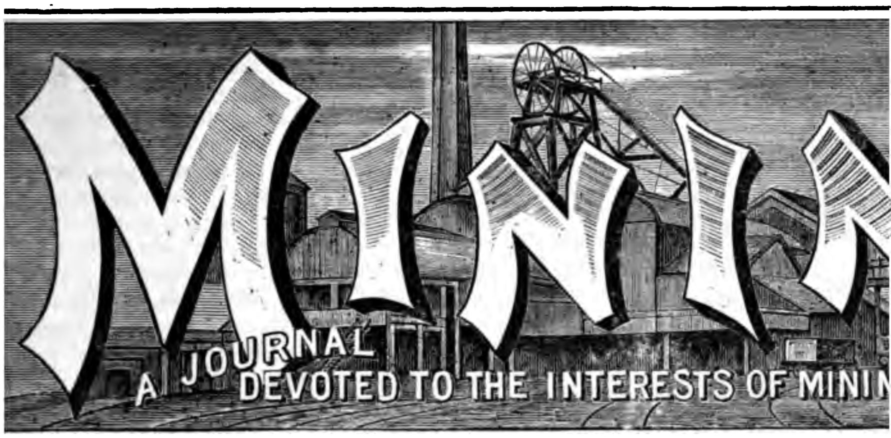


o 16. Vol. II. SATURDAY, JUNE 30, 1894. FORTNIGHTLY. ONE PENNY.

## CONTENTS.



# EASY LESSONS ON MINE SURVEYING

## For Beginners.

*Commenced in No. 2, Volume II.*

### MEASUREMENTS.—(Continued.)

#### HEIGHTS AND DISTANCES.

EXAMPLE.—What depth will it be necessary to sink a perpendicular shaft at the point B to reach the seam of coal which out-crops at A, A and B being in the same level plane?

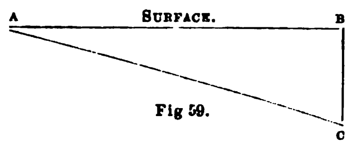


Fig 59.

Measure the distance A B, and by means of a clinometer ascertain at the out-crop the dip of the seam in the direction of AB. Draw a horizontal line on the paper, to scale, equal to AB, and plot the angle BAC with a protractor. Draw a perpendicular from the point B until it meets the line AC, and measure BC with the scale. This will be the required depth.

#### OFF-SETS.

When it is necessary to fix an irregular figure on a plan, such as the side of a field, it is effected by staffing out a straight line, as near the hedge as is convenient, and taking off-sets to the bends.

Off-sets are short measurements taken at right angles to the adopted straight line, from some definite point to the object which is required to be put on the plan. It is apparent that such measurements, to be correct, should be exactly at right angles to the main line, as that is the position in which they are plotted, and, as a right angle is simply guessed when taking off-sets, it is necessary that such measurements, to be correct, must be comparatively short. The length to which off-sets should be taken depends upon the scale to which the plan is to be plotted, and, in the writer's opinion, they should not be longer than will represent on the plan two-thirds of an inch. For example, if the scale is to be thirty yards to an inch, the off-sets should by no means exceed twenty yards in length, or, if thirty feet to an inch, not longer than twenty feet.

Short off-sets can be quickly taken by means of a staff ten links in length, or painted in feet if so desired, but for long off-sets a tape is the best.

Fig. 60 shews the plotting from a field-book, as given at a recent examination. It represents an irregular field which was surveyed by running one base line through it from end to end, with off-sets, taken on both sides of the line, to the bends.

#### THE FIELD-BOOK.

The measurements are given below as represented in the field-book. The field-book consists of un-ruled paper, with the exception of two parallel lines running perpendicularly

down the centre of each page, about half-an-inch apart, somewhat similar to the manner shown below, but they are usually drawn in red ink. The measurements of the line at which the off-sets are taken are placed between the red lines, and the length of the off-sets are placed immediately opposite the length, on the right or left of the book as the case may be, always booking upwards.

| Links. Left Off-sets. | Links. B | Links. Right Off-sets. |
|---|---|---|
| | • | |
| 150 | 155 | Crosses hedge |
| 182 | 130 | |
| | 1248 | 175 |
| | 1159 | 55 |
| | 980 | 183 |
| 230 | 865 | |
| 232 | 393 | 92 |
| | 150 | 75 |
| 145 | 45 | Crosses hedge |
| | • A | |

### — Plan of Field. —

taken from 45 on the chain to the bend in the hedge, and is found to be 145 links. This is booked on the left-hand side of the book, opposite to the 45 in the centre column. It is usual to make a rough sketch of the object to which the off-set is taken on the side of the book, but it is not necessary in this case as there is nothing but the hedge to be off-set, so no mistake can be made. There are no more off-sets necessary on the first chain, so it is taken forward another length, and it is then found that a bend in the hedge on the right-hand side necessitates an off-set being taken at 50 links on the second chain—that is, at 150. The 150 is booked in the centre column, and the off-set, which is found to be 75, is put on the right-hand side of the book opposite the 150, and thus the whole field is surveyed. This is only a possible method of surveying the field, and serves to illustrate the system of

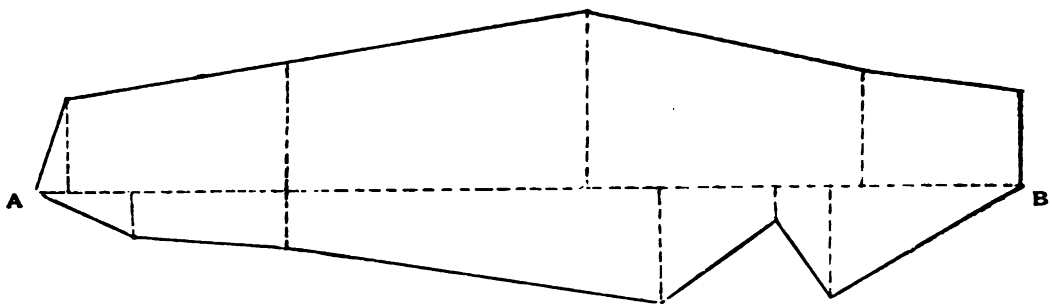


Fig. 60. *Scale: 3 Chains to an Inch.*

The method of procedure in surveying a field, as shown in plan, by running one line alone, would be as follows:—Staff out some such line as AB, then commence measuring from A. Having got the, chain stretched out the surveyor commences at the bottom of the book, and writes down that the chain crosses the hedge at *o*—that is, the commencement. He then looks at the hedge to see if there are any bends to be off-set on the first chain, and finds that the first bend comes in on the left-hand side, and that a right-angle (as ascertained with the eye) will cut it if taken from 45 links on the chain. A measurement is therefore

off-setting, but it is very improbable that any surveyor would do the work tn this manner as the off-setts are too long, and it could be surveyed much more accurately, and perhaps more quickly, by triangulation.

To plot the above, a line is drawn on the plan, to scale, to represent AB, and the off-set, at right angles to AB, pricked off at the required distance, when the several points are connected.

A more lucid account of plotting offsetts will be given next issue.

(*To be continued.*)

## ON THE DEEPENING OF A SHAFT

AT HULTON COLLIERY, LANCASHIRE.

By Mr. JAMES TONGE, F.G.S., Assoc. M. Inst. C.E.

(Read before the Manchester Geological Society.)

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The pit in question is one of a pair, situated at Chequerbent, belonging to the Hulton Colliery Company. No. 1 is the downcast, and is 200 yards deep, to the "Three-quarters" *mine* which is being worked there. No. 2 pit, of which we have to speak, was an upcast; but was only down to the "Yard" mine, a depth of 140 yards. It was thought desirable to sink this pit down to the "Three-quarters" mine and so make it the upcast for that mine as well as for the "Yard." But as it was not convenient to stop the working of the "Yard" mine it was decided to go on with sinking only in the night. The pit was 12 feet diameter, brick lined, and there were two cages carrying two tubs each. There were four

ıctors, and these were fixed diagonally ᵹ cages, and tightened by heavy iron ıts in the sump hole. As the cages were 3ft. 2in. wide and 7ft. 4in. long, with clearance between cages, it was very that there was not room for the ordinary r's wagon, or "jiddy" as it was termed, run across the pit without some altera- n the position of the conductors. How er the conductors so as to entail little ıt the beginning and so as to be most ːnient whilst sinking and coal winding being carried on alternately night and was the problem to be solved. After dering the various circumstances and tions that might reasonably be expected ːse, the following course of procedure ıxed upon and carried out:—

It was decided not to disturb or inter- t all with either of the winding pulleys ː headgear, or with either winding rope ge; that during winding over the sinkers vo cages should remain attached to the and run up and down the pit exactly ıen winding coal.

That the dirt should be wound up *one* f the shaft only.

That the dirt should be wound up to 'ard mine in the hoppets and be there .ed into tubs.

That as it was not possible that the could go below the Yard mine an addi- ı length of rope equal to the depth to be should be attached to the winding rope ɔus to sinking each night and detached sinking.

That to make room for the "jiddy" to n across the pit, the outside conductor d be removed to the other side of the cage.

ese were the only alterations required. may be briefly summarised thus:—

Taking weights off conductors after ing them by screws at the top.

Attaching a short connecting chain to nd of the winding rope to hang perma- y until sinking was completed, and get- 60 yards of rope to be attached to the ı each evening and detached each morning.

Moving one conductor; drilling holes ıe cage for thimbles; taking out one ːr from the sump hole and putting two ːrs at the Yard mine for the wagon to n.

The whole was carried out exactly as decided; no alteration or deviation was found to be necessary, and no accident or hitch of any kind occurred to render the plan in any way objectionable.

The procedure each evening, after coal winding, was as follows:—

1. To lift the cage from over the sump.
2. To take off the scaffold planks covering the sump.
3. To run the wagon over, upon which stood the hoppet with the 60 yards of rope coiled round.
4. To couple the rope to the end of the short chain under the cage.
5. To lift the cage slowly whilst the rope was carefully lifted from around the hoppet.

Preparations were now complete. Time occupied, twenty minutes. On completion of sinking each morning the time occupied in preparing for coal winding was the same, but in reverse order, of course. During the night, as each hoppet of dirt was sent up, it was emptied into tubs, as already noticed, and run along a level road as far as required, say, 100 yards at farthest, or an average of 50 yards. The empty tubs were left ready each evening after coal winding was finished. The sinking was always finished about four o'clock, and a couple of men were appointed to send up to bank the dirt got during the night by the sinkers. This was considered to be the only weak point about the work, the emptying into tubs and running them along the road into the "Yard" mine, and then fetching them back to put in cages. But this loss was estimated to be more than recouped by the facility with which the dirt was got rid of at the surface through being in tubs. A little handy jig ran the full tubs down a brow to a dirt heap, and brought the empties up with great despatch. And there was much less winding over the sinkers' heads, and the banksman was nicely within speaking distance. The plan adopted was found to be satisfactory to owners, managers, and men, and when afterwards a second length was to be sunk the same plan was again adopted. The sinking was commenced on August 4th, 1890, and the 60 yards was completed on December 9th following, and the shaft lined with 9 inch brickwork, set in mortar and made solid behind brickwork with concrete, the brickwork being laid upon iron rings supported by iron plugs driven in the sides.

# EXAMINATION QUESTIONS,

WITH ANSWERS BY

JOSEPH CARTER, First-Class Certificated Manager.

*(Continued from No. 15, Vol. II.)*

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

### Subject.—

### COLLIERY PLANT & MACHINERY.

QUESTION 1.—State what materials you would consider suitable for foundations for a large winding engine, and give the estimate cost per cubic yard of foundations constructed of such materials, either under ordinary conditions or in the case of any work you have been connected with.

ANSWER.—The foundation should be in solid ground, otherwise injurious settlement to the structure and the working of the engines ensues. When the ground has been bad a good bottom should be prepared by walling a space somewhat larger than the engine-house and filling in the interior with concrete, which is well grouted and brought up level with the bottom of the pillars. On this, after allowing time to settle, the pillars are set out. First operation is leaving the hand-holes, which should be large enough to allow the bolts to be got at easily; over these hand-holes stones or iron plates are placed, having holes ½-inch larger than the bolts. In building pillars, openings should be left for pipes and shafts. All bolt holes should be vertical and free from refuse. Stone, brickwork, and concrete are the materials required. Foundations may be built in three ways:—(1) All stone work, which is very expensive and unnecessary. (2) All brickwork except one stone course on top. (3) Brickwork casing with concrete inside; this is the least expensive.

The cost of pillars for horizontal engines with 30″ cylinder and 5′ stroke would be about:—

| | Per cu. yard. |
|---|---|
| All stone... ... ... ... ... ... ... | 11/– |
| *Brick and stone* on top ... ... | 8/6 |
| *Brickwork casing and concrete* ... | 7/4 |

The following may be taken as dimensions of pillars for a certain size of engines:—

| Size of Cyl'der. Inches. | Engines. Stroke. Feet. | Length of Pillars. Feet. | Depth of Pillars. Feet. | Width of Pillars. Feet. |
|---|---|---|---|---|
| 18 | 3 | 20 | 9 | 4½ |
| 24 | 4 | 30 | 12 | 5½ |
| 30 | 5 | 40 | 15 | 6½ |
| 36 | 6 | 50 | 18 | 7½ |

The above dimensions are for brickwork with stone top.

QUESTION 2.—Compare the relative merits of the Cornish and Lancashire types of steam boilers.

ANSWER.—Cornish boilers owing to having only one internal tube are only suitable when small powers are required because of insufficient fire-grate area. Should boilers of great power be required of the Cornish type a very large furnace flue would be necessary. Flues of large diameter are weak and liable to collapse. Thicker plates might be used, but thick plates are undesirable in steam boilers. The Lancashire boilers have two internal tubes, which give more fire-grate area and a much larger heating surface than the Cornish boilers, and consequently a much better percentage of work done, which renders them far more suitable when large powers are required.

QUESTION 3.—Give a full list of the mountings and fittings you would specify for a first-class Lancashire boiler to work at a pressure of 70lbs. per square inch.

ANSWER.—The ordinary size of a Lancashire boiler is 27 feet long and 7 feet diameter. Two internal flues, each 2 feet 9 inches dia., with five Galloway tubes in each flue. The following mountings and fittings for such a boiler would be requisite, viz.:—One of Cowburn's dead-weight 4-inch safety valves, one of Hopkinson's compound high steam and low water 4-inch safety valves, one steam 6-inch junction valve with pipe in the interior of the boiler perforated to take steam only at the top, and one man-hole cover; on the bottom, one 3-inch blow-off valve, and on the front, one 3-inch feed water valve with distributing pipe passing into the interior, one scum valve with collecting trough passing into the interior, one man-hole cover, one steam pressure guage, and two sets of water guage taps and glasses. The furnace flues to have at the front, wrought-iron mouth pieces, and each mouth piece to have a cast-iron door with a sliding ventilating grid outside and a perforated box baffle plate inside. Each

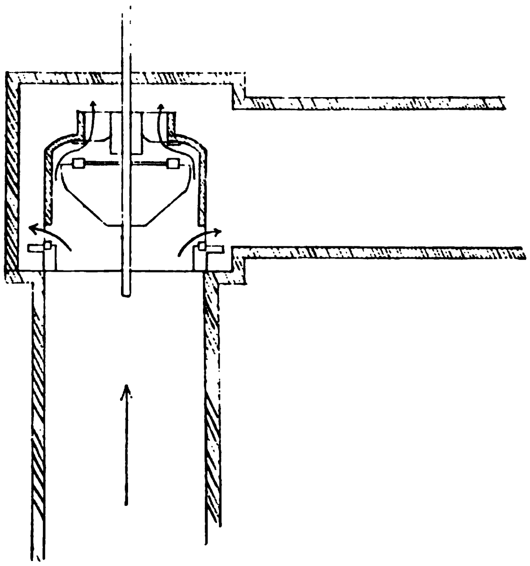
furnace flue to be fitted with a fire-grate, 6 feet long, with requisite dead plates and cross bearers; the inclination of the fire-grate being 1 in 24.

QUESTION 4.—If you had to set the eccentric and slide valve of an ordinary engine in their right positions explain how you would do it.

ANSWER.—In order to set the eccentric in its proper position I would put the engine on dead centre, placing a spirit level on the crank so as to obtain its true centre. When this is done I would key the eccentric (which consists of a circular plate attached to the crank shaft) $\frac{1}{16}$ of a revolution in advance of being at right angles to the crank. The slide valve is also set in position while the engine is on dead centre, and put so that the port-holes are covered, with the exception of a very small opening about $\frac{1}{16}$ or $\frac{1}{8}$ of an inch.

QUESTION 5.—Make an ink sketch of an equilibrium or double-beat valve.

ANSWER.—See sketch.



**Double-beat Valve.**

(*To be continued.*)

**COLLIERY EXPLOSION NEAR PONTYPRIDD.**

**As we go to press we hear of a terrible explosion that occurred at the Albion Colliery, Cilfynydd, near Pontypridd, on Saturday last, by which 251 lives were lost. It is not yet decided whether the explosion was caused by coal dust or gas, but in any case the sacrifice of so many lives is appalling. We can only express our great regret and sincerely sympathise with the bereaved relations of the deceased men.**

# COMPETITION QUESTIONS.

TO the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d.**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. In accordance with our custom the best answer to *each individual Question* will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."

2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3.—Correct name and postal address must be sent.

4.—They must reach us by July 13th, 1894.

5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—What are shafts, stopes, and winzes? Show the application of those terms in a sketch of a mine on a lode.

*Question* 2.—Describe briefly how circulation of fresh air is kept up through the workings of a large mine.

*Question* 3.—Describe the principle of main-and-tail rope haulage underground.

### ADVANCED.

*Question* 4.—Describe, with sketch, the South Wales method of single-stall workings.

*Question* 5.—How is a coalfield containing a large number of seams with a high dip laid out for working.

*Question* 6.—Give an account of the Lancashire and Cheshire coalfield.

### FIRST-CLASS.

*Question* 7.—Describe, with sketch (plan), what you consider to be a good arrangement of the tram roads of a heapstead. Show also the usual plant of the heapstead.

*Question* 8.—Construct a table of mine gases, including the simple gases, giving the names, chemical formula, composition, and weight, as compared with air and hydrogen, and properties of each as regards supporting life, combustion, and combustibility.

*Question* 9.—Describe how you would fix wire rope guides in a shaft, and give an approximate rule for the weight of conductors to use, and the weight to attach to the conductors to keep them tight. If the weights in the sump were covered with water, and you wanted to know if they were hanging properly, how would you proceed supposing it is not practicable to empty the water.

# MR. A. H. STOKES' SAFETY LAMP.

*With Standard Alcoholic Flame Adjustment for the detection of small percentages of inflammable gas.*

It has been distinctly shown by numerous experiments, conducted during the past few years, that a percentage of gas, much less than can be detected with the ordinary lamp, is dangerous in a dusty mine, and may be the cause of an explosion. This necessitates more accurate testing appliances than have heretofore been employed, and several arrangements have been invented for the detecting of small percentages of inflammable gas; but the great drawback has been that most of them are inapplicable for underground testing in so much that they are inconvenient and require delicate usage. The recent invention of Mr. A. H. Stokes is however a very convenient and accurate arrangement, and is capable of detecting as little as ·5% of an explosive gas.

the ordinary Gray officials' lamp with the addition of a tube *b* (Figs. 1 and 2), which passes through the oil vessel; the bottom of the tube being closed by means of the screw *c*.

When testing for inflammable gas the lamp as shown in Fig. 1 is used, and the ordinary oil-flame *a* is noted for indications of gas. If the presence of gas is not indicated with the oil-flame and it is thought advisable to determine whether a still smaller percentage than can be appreciated with the oil-flame is present the alcohol tester is adjusted.

The tester (Fig. 4) consists of a small lamp, the vessel *e* of which contains pure alcohol. The wick consists of two strands, drawn from the round wick used for oil in safety lamps, and it is drawn through the long tube of the tester and cut level with the top. The slit *i* across the tube gives the standard flame. The tester is very small, and when not in use is protected by a cover *f* (Fig. 3) and can be thus carried in the waistcoat pocket.

FIG. 1.

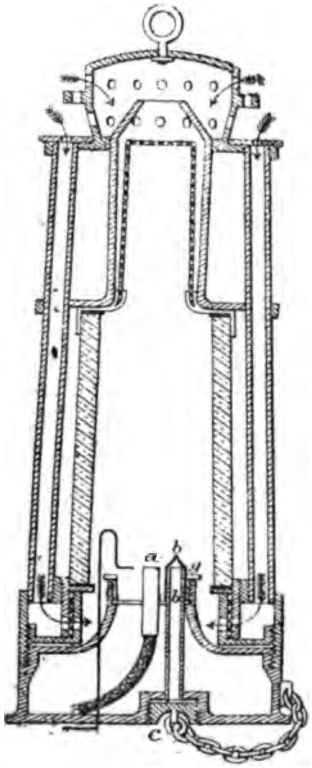
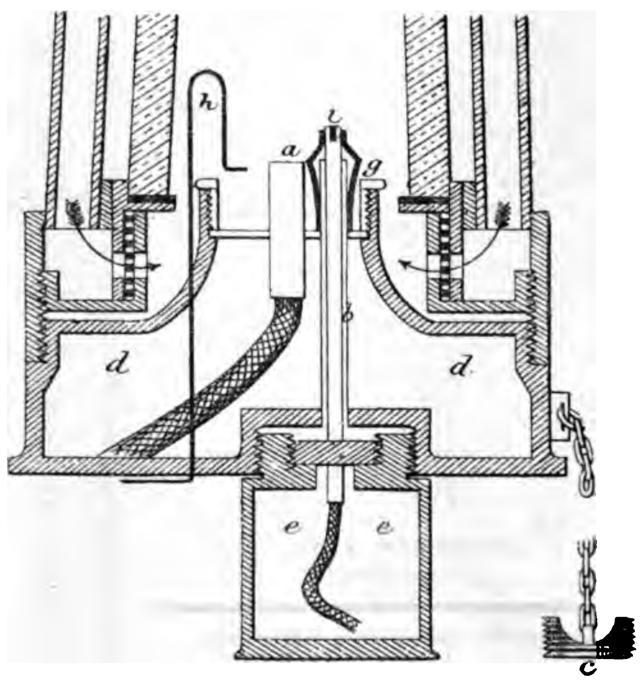



FIG. 2.




The accompanying illustrations of this lamp will enable the reader to understand clearly the principle adopted. The lamp is in reality

To use the tester the brass plug *c* (Figs. 1 and 2) at the bottom of the lamp is unscrewed and the tube of the tester is inserted and is screwed up full (Fig. 2); then, after waiting a few seconds until the heat causes the alcohol

Fig. 3.

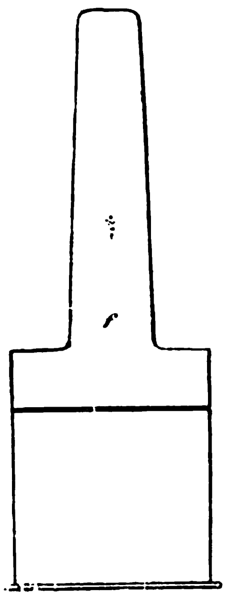
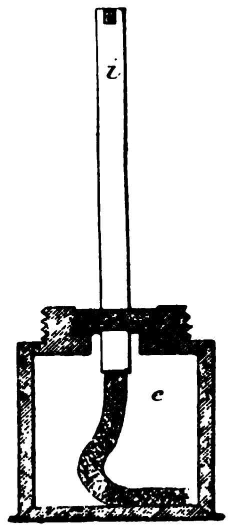



Fig. 4




to ascend in the tester, the alcohol is then ignited from the oil-flame. To expedite the ignition the lamp may be held leaning slightly to one side, so that the oil-flame touches the top of the alcohol tester. When the alcohol flame has reached its standard height the oil wick is drawn down and the light extinguished. After the test is made the oil wick is raised, bent over by the pricker, and lighted by the alcohol flame. The alcohol vessel is then unscrewed, the plug put in, and the lamp becomes the ordinary safety lamp.

The gas caps are as follows :—

| Per cent. of Gas. | Inch Gas Cap. | Remarks. |
| --- | --- | --- |
| ·5 ... | ·60 ... | Very pale, not clearly seen. |
| 1·0 ... | 1·00 ... | Pale blue, clearly seen. |
| 1·5 ... | 1·44 ... | Pale blue, clearly defined. |
| 2·0 ... | 1·68 ... | Clear blue cone. |
| 2·5 ... | 2·00 ... | Distinctly definite gas cap. |
| 3·0 ... | ... | Oil-flame used. |

The lamp is manufactured by Messrs. Davis and Son, Derby.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to Strowger and Son, Clarence Yard, Wallgate, Wigan.

## ANSWERS TO CORRESPONDENTS.

Received :—Colliery Engineer, Technical World; also R. Mather and Reader.

T. M.—The Colliery Managers' Examination was held at Wigan, on the 20th and 21st June.

R. P.—Glad you like our new arrangement of the Competition Questions. It is true there are not so many awards, but the increased amounts make them worth competing for, and more honour is due to a winner than before.

Blasting.—A summary of explosives with the composition of each is given in No. 23 of Vol. I.

R. N.—We shall be pleased to publish and pay for suitable original matter.

## EDITORIAL CHAT.

Those of our readers who did not happen to read the notice in the last issue will be surprised to see the old familiar pink cover discarded, and a white one in its stead. We have adopted the white cover to facilitate the speedy production, and hope that our readers will see no objection, so long as the paper contains the same instructive and interesting matter. We have determined to effect another change, viz.:—in the Competition Questions, and we have arrived at this decision from two causes. The first is that some competitors do not receive the paper until long after the date of issue, and are, in consequence, unfairly handicapped in the competitions, as they have not sufficient time to answer them. Another reason is that very little time is allowed us to read over the vast quantity of answers which are received, and the making of sketches to illustrate them. We will, therefore, in future give the competitors nearly another week to answer the questions, and the answers will be published an issue later than is the case at present. For example, the questions given in this issue will not have the answers published until No. 19. This will necessitate one issue, namely, No. 17, being without Answers to Questions, but we shall contrive to introduce some new feature to replace them.—The Editor.

### RECENT IMPROVEMENTS
IN
## MINING MACHINERY & APPLIANCES
BY
MR. WM. SAINT, H.M.I.M.

(Address read before the Manchester Geological Society.)

*Continued from last issue.*

### TRANSMISSION OF POWER.

Next to self-acting inclined planes, perhaps the most economical system of underground haulage for dealing with large outputs over roads uniformly level, or of moderate uniform gradients, with or against the load, is a slow speed endless rope (or in case of a wet mine a chain) carried upon the tops of the tubs, placed at moderate distances apart. The ropes being kept off the floor, wear and tear are reduced to a minimum and they are found to last many years. The steam engines are better fixed on the surface and the driving ropes carried down the shaft to the driven pulley. Moderate outputs, say 250 tons a day, are also economically hauled by this system up brows inclining 30° to 40° from the horizontal, but in such cases it is found desirable to run the rope beneath the tubs and to use clips specially devised to adjust themselves to the rope under the varying conditions of the load.

Where large outputs have to be hauled up steep gradients it is the practice to use single ropes. When the brow is in direct line with the pit the engines are sometimes erected on the surface, but in others are fixed near the pit bottom and worked by steam generated on the surface or below ground. But underground fires have resulted in a few instances from radiation of heat from the steam pipes, and if, for particular reasons, the engines must be placed underground the best practice is to use compressed air as the motive power, and particularly is this desirable in fiery mines, or where power is required long distances away from the shaft bottom. This is a matter of considerable importance, because it is often found more economical to employ small engines to wind from the dip in the interior of the mine than to use horses or manual labour for that purpose.

Electricity has been successfully applied for the transmission of power underground, both for haulage and pumping purposes in many mines. The current is generated on the surface and conducted by an insulated copper cable to a motor, which may be geared by belt, rope, or spur gearing to the machinery. The return current may be conducted by old ropes laid on the ground. Since its first introduction as a motive power in mines improvements have been introduced with a view to prevent the possibility of ignition of explosive mixtures of fire-damp and air, either by sparks from the commutator or an acc;dental severance of the cables; but, even with these precautions, it is for engineers to consider whether the cables and motors can be safely placed in positions where a naked light cannot be used. Its introduction has passed the experimental stage, and there is every probability that its application will be largely extended. It is, therefore, desirable that all connected with the management of mines should acquire knowledge of this truly wonderful medium of transmitting power.

Electrical signals are very extensively used in the shafts and on haulage roads. The wires are sometimes utilised for the transmission of telephonic messages between the surface and the several stations on the haulage roads.

### COAL CUTTING MACHINERY.

Coal cutting machinery has not been adopted on a large scale in this country, probably owing to the fact that, as a rule, they are only applicable to longwall workings, in which the coals are not usually difficult to get by manual labour. This, however, does not apply to the Stanley heading machine, which is designed for driving narrow roads. It consists of a series of radiating arms, supported on a shaft, carrying longitudinal cutting bars, which are revolving against the face of the heading by means of a pair of small vertical engines and powerful gearing driven by compressed air. The bars make an annular cutting, leaving a central core of coal, which is broken up by wedging and removed by the hand. The length of the cut is about twenty inches, and under favourable conditions the speed of driving is from three to four feet an hour. The machine has been thoroughly tested during the past few years and it is a practical success. Its chief merits are the increased proportion of large coal obtained from narrow roads and the saving of time in executing a given quantity of work.

(*To be continued.*)

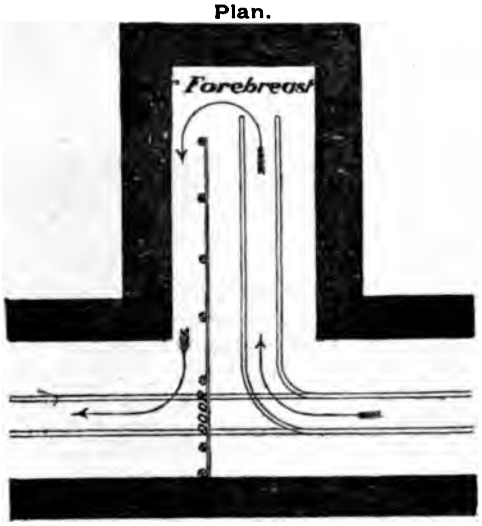
## ANSWERS TO QUESTIONS

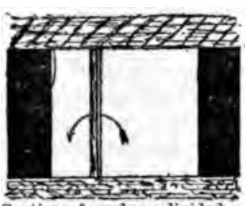
**In No. 14, Vol. 2.**

**ELEMENTARY.**

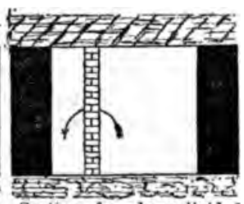
*Question* 1.—Describe with sketch how the forebreast of a level is ventilated.

**Plan.**



Section of roadway divided by brattice.



Section of roadway divided by brickwork.

*Answer.*—The mode of ventilation would depend on the length of the level and quantity of gas given off. The entrance to the level is first divided by a canvas partition, one side being wider than the other, the widest being for the entry of the air, and the other or narrow side for its exit, so that the narrow side carries the gas from the workmen. The sheets of canvas are nailed on to bars of wood about three inches broad and two-and-a-half inches thick, and vertical props are set at regular distances, and about two feet from the side. The bars I would use would be nine feet long, the bars to meet on the crown of the props. There are other ways to get the air to the fore-breast, namely, by sheet-iron pipes, or by canvas pipes fitted with rings of sheet iron, four or six feet apart, to give rigidity. For long distances a brick partition is best, as it can be made thoroughly air-tight, and it supports the roof. If shot-firing be carried on, the brick brattice must be kept six to eight yards from the face to avoid damage by shot, and canvas brattice connected up to face.—J. T. WARD, Markham Cottages, Duckmanton, near Chesterfield,

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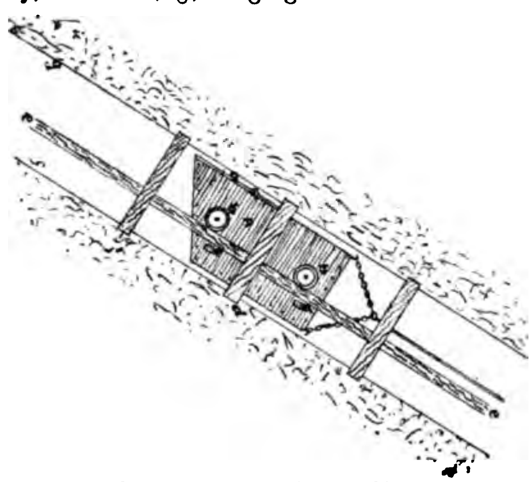
*Question* 2.—What methods of guiding skips or cages are used in vertical and inclined shafts respectively?

*Answer.*—The method of guiding cages in a vertical shaft is as follows:—The wire or flexible conductors pass through a hole in a beam near the top of the headgear, and are secured at the top side of this by means of clams which tightly grip the wire rope, and so keep them suspended in the shaft, the number of clams varying according to the depth. At the bottom, the conductors pass through beams in the sump, and a little below these are hung the weights, which keep the conductors tight and free from oscillation. The cages are provided with slide boxes at the top and bottom, which pass round the guides.

*Sketch of above appeared in* *No.* 8, *Vol. II, page* 93.

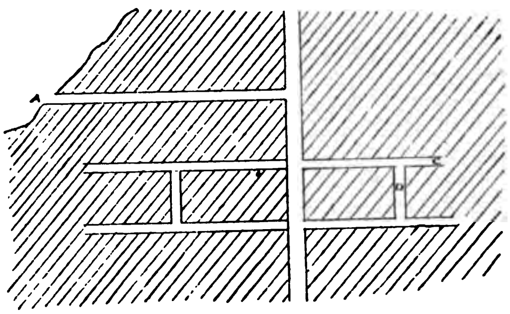
The skip with a hinged door at *a*, wheels *b*, and guide pieces *cc*; *dd*, cross timbers let into the sides of the shaft; *ee*, guides; *f*, foot-wall; *g*, hanging-wall of lode.



**Section of Inclined Shaft.**

The skip is filled sometimes at the upper end, but at times the rails are bent round so as to allow it to take a horizontal position at the bottom of the shaft, when it is filled by opening the hinged door. The skip runs on wheels along the rigid guides (*ee*), and the guide-pieces (*cc*) keep the skip in its proper position. — JOHN STEPHENSON, Wharton Street, Coundon, Bishop Auckland, Durham.

*Question* 3.—What is an adit level? Give sketch and mention some of the most remarkable.



A Adit. C Level. D Winze.

*Answer.*—An adit is the water level of a mine. When a level opens to the surface at the side of the valley, it forms what is termed an adit or day level. When a mine has been opened by sinking down from the surface, as is most usual, an adit is commonly begun from the bottom of some neighbouring valley, and is driven towards the vein, with a slight inclination to allow the water to flow through it. One of the most wonderful works of this kind is the great adit of Cornwall, through which the waters of the mines in Gwennap and Redruth are discharged. Its length is nearly 40 miles, the depth varying from 60 to 180 yards. Another great adit, known as the Erust August Adit was finished a few years ago in Saxony, and drains a large series of mines in the Hartz Mountains, some of them to a depth of 444 yards. This adit, with its branches, is 14 miles in length, and has a gradient of 1 in 2,000.—JOHN STEPHENSON, Wharton Street, Coundon, Bishop Auckland, Durham.

## ADVANCED.

*Question* 4.—Explain the terms rubbing surface, area, perimeter, and section of an airway, and determine them for a rectangular level 6 feet by 7 feet, 500 yards long.

*Answer.*—Rubbing surface means that surface of an air-way against which an air current must rub in its course through the air-way. The elements of rubbing surface are:—first, the perimeter of the air-way; second, the length of the air-way. The unit of rubbing surface is taken as one square foot, and the perimeter; and the length of the air-way is always expressed in linear feet. The rubbing surface is found by multiplying the sum of the four sides which enclose the section, or the measure round about by the length of the air-way.

Area means the superficial contents of an enclosed space. The area of any plane figure is the measure of the space contained within its boundaries, without any regard to thickness, and the area of a rectangular air-way is found by multiplying the height by the breadth.

Perimeter means the boundary of any enclosed figure, being the sum of all the sides in right-lined figures which enclose the area of section, and means the same as the circumference, or periphery, in circular figures.

Section of an air-way means an area that has been cut or divided, and may be conceived by the mind's eye looking into the end of an air-way. Therefore, the rubbing surface, area, and perimeter of an air-way, which is a rectangular level, 6 feet by 7 feet, 500 yards long, is found as follows;—$\therefore 6 \times 7 = 42$ square feet, area of section. $\therefore 6 + 6 + 7 + 7 = 26$ linear feet, length of perimeter. $\therefore 6 + 6 + 7 + 7 \times 500 \times 3 = 39{,}000$ square feet of rubbing surface.—JAS. BURROWS, 103, Chapel Street, Dalton-in-Furness.

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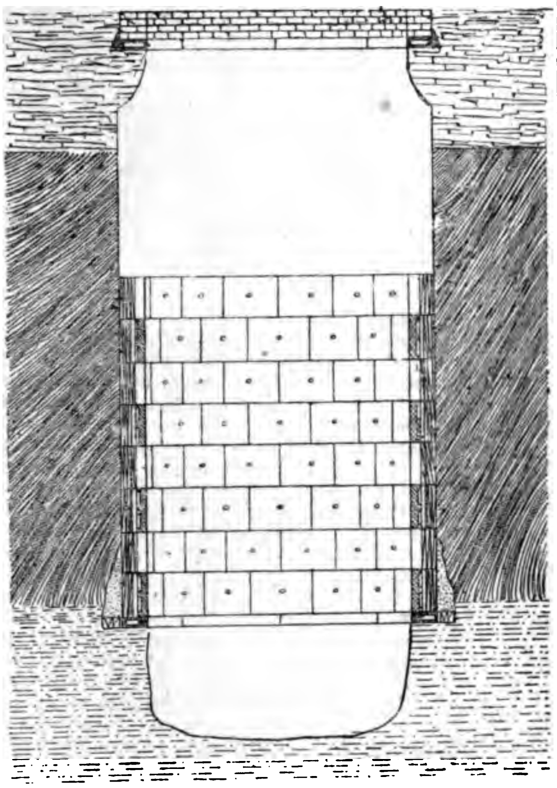
*Question* 5.—How can cast-iron be used for securing shafts and levels?

*Answer.*—At many collieries cast-iron or metal tubbing is put in to secure shaft sides, and iron and steel props and girders are rapidly and progressively supplanting timber to support and to secure the roof of levels, drifts, pass-byes, shaft bottom, etc.

The cast-iron tubbing becomes necessary in shafts when the sides are of a soft, loose nature, and are required to be sustained at a high pressure, such as water feeders, gravel, or quicksand, and different conditions of pressure. When an accumulation of water or quicksand is at a certain distance (which has been proved by boring), tubbing lining must be resorted to. The tubbing varies in thickness, but is never less than $\frac{5}{8}$ or $\frac{3}{4}$ of an inch thick. The mode of procedure to line a shaft is as follows:—A good rock having been found, free from joints or slips, the sides are shorn back to form a foundation, bed, or shelf. Then, a wedging crib in the form of a box-shaped ring of cast-iron, from 1 inch to $1\frac{1}{2}$ inches thick, 18 inches to 24 inches wide, and 6 inches to 9 inches deep, in convenient segments to form the circle according to the size of the pit, are laid on this shelf, bed, or good rock foundation, on which the cylinder of tubbing is next built. The tubbing is put in in segments varying in length and number,



**Shaft Tubbing.**

according to the diameter of the shaft, from 1½ to 2½ feet deep, 3 to 4 feet long on the curve, and about 10 inches wide in the bed, with flanges on the four sides, and strengthened with horizontal and vertical ribs. They are one by one tested and set round the shaft until they form a complete ring, with ½-inch pine sheathings placed between all joints, under sides, and top of the butts, and then the tubbing is wedged from behind. By this means they are wedged true, tight and safe to the circle of the shaft. The vertical joints in each series are crossed by the next above as in ordinary brickwork. Every segment has a hole in the centre for the escape of gas and water. The space behind is filled up with broken stone, called backings, mixed with cement washing or concrete. Thus the tubbing is extra strengthened, and the backing is left sufficiently porous for the escape of gas, &c., at high pressure. If the pressure is unduly great, vertical pass pipes are fixed from the higher to the lower lengths in branches, having valves to regulate or to relieve the back pressure, these are called escape connecting safety pipes. Each segment being numbered and marked, they can be put together in the pit as quickly as they can be lowered and with very little labour. In the top ring the last plate is made in two pieces, with 2 inch strips of iron, flanges and bolts pass through these strips and the adjoining flanges, so as to give more security and efficiency to the tubbing.

(2nd) Cast-iron has not and never will come much into use to support roads in the mine, &c., as it gives no warning in breaking, does not yield like wrought-iron, and is not so useful, safe, and serviceable as steel.—S. Davies, Park Road View, Worsboro' Bridge, near Barnsley.

*Question* 6.—Give some account of the use of electricity in blasting operations.

*Answer.*—Electric blasting is now very much employed in mining operations, and its use is attended with very many advantages over the old method of firing shots. The holes being drilled in the usual way, great judgment must be displayed in selecting the place for the holes, their angle of direction, and depth of boring. In sinking, drifting, and blasting coal (General Rule 12, Clause *d*, of the C.M.R.A., 1887, must be carefully observed), the method of firing shots is very simple, and consists principally of three methods, viz.:—(1st) Before the hole is charged and rammed, a small detonator cap about ⅝ of an inch in length, cylindrical form of copper case, filled with either one grain of fulminate of mercury, or chlorate of potash, and sulphide of antimony. This is hermetically sealed at one end and open at the other to admit the safety fuse, which is placed into the open end of the cap. The cap is inserted into the explosive or cartridge, the end being securely tied round, then put into the hole and rammed. The electric fuse consists of two insulated fine platinum wires, bare ends being brought close together in the primer, and the wires from 4 to 5 feet long. These are attached to a conductor cable which varies in length from 30 to 60 yards. In some cases there are two cable lengths, but we approve of the single cable length, which has four small wires covered over with gutta-percha and other waterproof material covering. This main cable is joined to the two conducting wires that hang out of the hole, and which is placed in the charge; then the fireman retreats and examines the cable when he reaches the outer end, which is expected to be a point of safety, and

where the electric generator or galvanic battery is placed. The cable is then attached and when all is clear a button is pressed while the machine handle is turned, and the multiplying gear and armature is made to turn rapidly between the two inside poles of the magnet, thus producing an electric current which passes in direct circuit through the wires, heats the priming and so causes the ignition of the charge. (2nd) The generating of the electric spark arising from a magnetic machine, and (3rd) by a spark from an electric condenser. When the passage of the spark between the joints of the terminals of the wire at once fires the fulminate of mercury in the detonator. I will just mention a few of the advantages which are as follows: — This method is much safer, as all men are out of the way before the current is put on, which is a very important point. Shots are fired immediately and simultaneously, and more effectively. There is a great saving of time and less danger in going back when shots have missed fire, and the working place has not to stand because there is no danger of "hanging-fire;" a number of shots can be fired at the same time. Safety lamps need not be unlocked to fire the shot. This method, no doubt, has a grand progressive future before it in mining, quarrying, and tunnelling operations.—S. Davies, Park Road View, Worsbro' Bridge, nr. Barnsley.

*Answer to First-class Question will appear next issue.*

## AWARDS

For Answers to above Questions.

Elementary.—J. Stephenson.
*Commended.*—J. N. Wardall, W. P. Laws, W. Talbot, J. T. Ward.
Advanced.—S. Davies.
*Commended.*—T. Best, T. Banks, B. Nightingale, J. Burrows, A. Trowers, G. Daykin, H. Talbot, H. Hall, G. Ward, S. Chadwick, J. Wallwork, G. Robinson, J. Jackson, A. H. Meakin, J. Davis, M. Mourley.
First-Class.—W. Robson.
*Commended.*—G. A. Hawes, T. Smith.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm *that we hold the same* views as the writer.

### Greatest Depth to which Mines can be Worked.

Dear Sir,—Apropos of the above I herewith give some results of observations which will help the determining of a decision as to the greatest depth.

In the first place, the increase in temperature due to increased depth is not influenced by the depth of the point of observation from the level of the sea but from the surface. To test this a series of observations were taken at Monkwearmouth Colliery 1,600 feet below the level of the sea, and in South Wales, where the coal was on a level with the sea but under a mountain 1,600 feet high, and the temperatures were almost identical. A well has been sunk recently in Wheeling, West Virginia, to a depth of 4,500 feet, and temperature observations were taken every 125 feet. At a depth of 4,000 feet the temperature was 102°, the surface temperature being about 51°, and at 4,500 feet 110·15°. The observations show clearly that the increase in temperature becomes faster as the depth increases: thus from 1,590 feet to 1,835 feet the rate of increase was 1° for 92 feet, and finally at the lowest depth 1° for 58 feet, the mean increase being about 1° in 72 feet. Recent observations during the sinking of a shaft in Belgium to 3,773 feet gives a mean increase of 1° for 54 feet, the temperature at the bottom being 116·6°, at the rate of increase of 1° in 54 feet, this would give, say, 120° for a depth of 4,000 feet. We may assume for present purposes at a depth of 4,000 feet the temperature to be 110°. This having been arrived at, two other subjects remain to be discussed, namely, the temperature in which men can do laborious work and the probable reduction which could be brought about in the temperature of the mine by good ventilation and the free use of compressed air. The first of these can be ascertained fairly correct by observations in present workings; but only an approximate idea can be taken of the second, and it is this which prevents the almost definite decision which could otherwise be given, and it can only be decided by practical working. With regard to the first, however, I have made observations in a deep mine, which was rendered unduly hot by reason of the difficulties attending the ventilation, and find that in some portions of the mine the men work in a temperature as high as 95°. It must be understood, however, that this temperature is more than most men can work in, and in this particular mine the coal is very easy to get, yet considerable difficulty is experienced in obtaining men to work in it. On the whole it is my opinion that a fair average of depth to which mines can be worked is about 4,500 feet, at which depth an average temperature of 120° may be taken; some may be worked below this and some not so deep. M. E.

### Sinking Shafts by Boreholes.

Dear Sir,—I would be obliged if any of your readers could provide me with data in support of the statement made to me with reference to the above subject. I do not mean the method known as the Kind Chaudron, but as I understand it, the boring of a series of vertical holes round the diameter of the proposed shaft, thus isolating a circular piece of strata which is afterwards removed by a species of sinking. I have not seen any reference to this kind of sinking in any of the principal books on mining. Interested.

### Winding Rope Splicing.

Sir,—I would be pleased if you would insert the following question in your correspondence page to be answered by some of your readers:—

What method would you adopt to splice a 5 or 6 strand winding rope, and oblige, An Amateur.

*Printed and Published by* Strowger and Son Clarence Yard Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MINING

Vol. II. SATURDAY, JULY 14, 1894. FORTNIGHTLY. ONE PENNY.


## CONTENTS.



## LKER COLLIERY, NORTHUMBERLAND.

WILLIAM ROBSON.

*wer to Question 7 of No. 14, Vol. II.)*

I am well acquainted with WALKER COLLIERY, I will try and give a description of it. This colliery is situated pon the banks of the River Tyne, in mberland, about three miles east of stle, and is one of the oldest working s in the North of England. The drawing shaft, which is also the down- called the Ann pit, and is sunk down to called the Brockwell seam, which is t a depth of 201 fathoms. The up-cast, pit as it is called, is about half-a-mile f the Ann pit, and is sunk down to the ont seam, a depth of 186 fathoms, but his seam was reached sinking operations opped, the coal in the Beaumont seam, pit, being only about two feet thick. As left unopened out the shaft became full r up to the level of the Low Main seam, which is a distance of 161 fathoms from the surface, so in order to keep the water from flowing into the return air-ways and blocking them up, a syphon is used which conveys it to the Ann pit. None of the seams are worked at all in connection with the Jane pit, although both the Bensham and Low Main seams have been worked, leaving the pillars standing, but only for about 300 yards to the north of this pit up to the great Coaly Hill Whin Dyke, which passes through the whole of the seams in an east and west direction.

The Jane pit is about 14 feet in diameter, and a winding engine is always kept in readiness here, in case of accident with the one in use at the Ann pit, or the shaft itself. A large GUIBAL fan, 35 feet diameter, is placed at the top for ventilation, being driven by a small duplicate horizontal engine with a 30-inch cylinder, 3 feet stroke, running at about 33 revolutions per minute, and giving a water-gauge of about 2·67 inches. The steam is generated for these engines by three of the old fashioned egg-ended boilers which were fired by BENNIS's mechanical stokers, but recently, the Agent and Manager, H. WHITE, Esq., took them all out and applied the Meldrum furnace, which is found to give splendid results, besides a great saving in the consumption of fuel. Then, passing on to the Ann pit, where all the coals are drawn, we find one of the old fashioned shafts in use here. It is twelve feet in diameter for a depth of 80 fathoms, and then is gradually widened out to about fifteen feet until the meetings are passed (see fig. 1), and again sunk down its original size until we reach the Brockwell seam, a depth of 201 fathoms. Wood guides are used in this pit, and iron wire rope guides in the up-cast. Both pits have a good deal of metal tubbing in them, especially where the shaft passes through the famous High Main coal at a depth

of 60 fathoms from the surface. There are seven seams of coal in this pit, which are found at the following depths :—

| | |
|---|---|
| High Main.. .. .. .. .. .. | 60 fathoms |
| Bensham .. .. .. .. .. .. .. | 136 ,, |
| 6/4 seam .. .. .. .. .. .. .. | 144 ,, |
| 5/4 seam .. .. .. .. .. .. .. | 152 ,, |
| Low Main ... .. .. .. .. .. | 161 ,, |
| Beaumont .. .. .. .. .. .. | 186 ,, |
| Brockwell .. .. .. .. .. .. | 201 ,, |

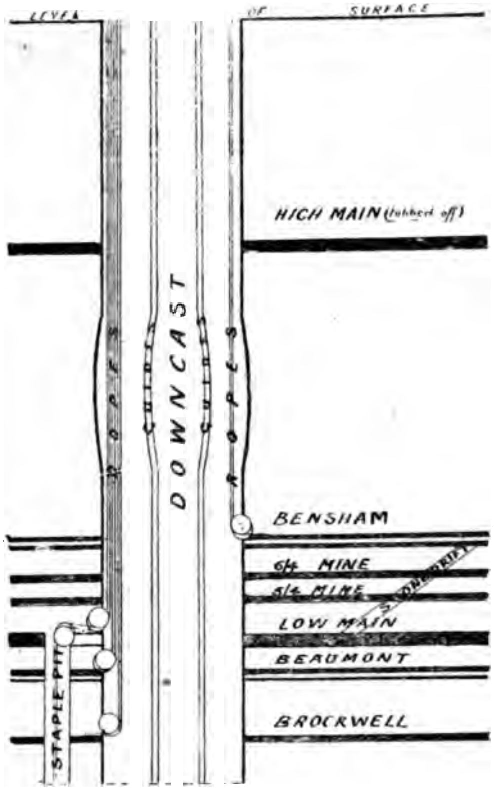



**Fig. 1.**
**Sketch—Section of Downcast and Staple Pit.**
**Staple Pit is Upcast for Beaumont and Brockwell Seams.**

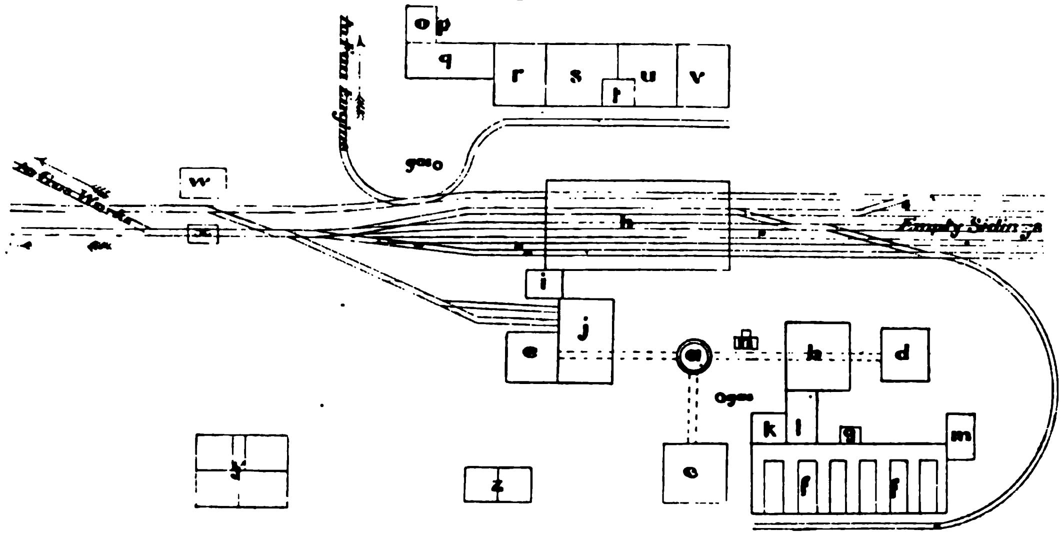
Five of the above seams are workable, but as for the 6/4 and 5/4 I do not think they have ever been tried. As before stated, the High Main is tubbed off—it being drowned out, but I may as well say that this is the seam which the famous mining engineer, Mr. BUDDLE, worked in the adjoining collieries.

The Bensham seam is working, and serves as both a good house coal and gas coal. When first opened out the seam was split by a band of seggar, fifteen feet thick. The top coal is one foot seven-and-a-half inches thick, and the bottom about one foot six inches thick, but as the workings advance to the east the band gets thinner, and is worked on the board and wall system, it being a shooting seam. Carbonite is the explosive used, and all shots are fired by electricity, and special firemen appointed. As the workings advance to the east and the band gets thinner, both seams will be worked together, and may some day be laid out on the long-wall principle. As this seam is worked during the night time the coals are run down a self-acting incline, with a gradient of twelve inches per yard, into the Low Main seam, which is also worked at night—the Bensham coals being hung on one side, and the Low Main coals on the other side. Gas is given off in the Benshaw seam, but not to a considerable extent. The return air passes down the incline from the Bensham into Low Main to the main return, as shewn in plan.—(Fig. 3.*)

The Low Main seam is a six-feet seam, and is of an excellent quality for gas-making. It is a very tender seam but easily worked, and is one of the oldest working seams of this colliery, being therefore nearly worked out. The thill or bottom is composed of a very soft seggar, which varies in thickness from two or three feet up to ten feet in places, and the roof or top is a good blue stone. The greatest drawback to this seam at the present time is, that too small pillars have been left in for the support of the waggon-ways and air-ways, causing an immense amount of shift-work to get the remaining pillars out, and with the seams below being worked, it causes the bottom to heave and the top to lower down. A large quantity of fire-damp ($CH^4$) is given off in this seam both from the coal itself and the large area of goave round about it, and had it not been for the perseverance and determination of the manager, H. WHITE. Esq., it would have been abandoned as unmanageable, the quantity of gas being so great, and the difficulty met with in maintaining proper air-ways for the ventilation. It was a frequent occurence during the time of any atmospheric disturbance, or a low pressure, to find the gas within thirty or forty yards from the downcast, where hanging-on was taking place, until he built a series of permanent stoppings, and put in a 2½-inch pipe and carried it to the surface, where he utilises the gas for illuminating purposes, both on the heap-stead and on the branch roads, as shown in fig. 2. This seam is a particularly dusty one, and the horse roads have to be watered almost every day. All the haulage is done by horses and inclined planes, the quantity being too small to pay for any mechanical haulage being advantageously adopted now. This and the Bensham seam, as mentioned before, are worked during the night time.

* **Illustrations not to scale.**

Fig. 2.



**PLAN OF SURFACE ARRANGEMENTS.**

REFERENCES:—

a—Down-cast Shaft
b—Winding Engine (Staple pit)
c—Winding Engine (Down-cast)
d—Hauling Engine (Beaumont)
e—Hauling Engine (Bensham)
f—Boilers
g—Chimney for Boilers
h—Screens
i—Token Cabin
j—Storage for Coal
k—Tub Workshop
l—Pick Cabin
m—Electric Light Engine
n—Weigh Cabin
o—Boiler
p—Chimney
q—Sawmills
r—Wagon & Fitters' Shop
s—Joiners' Shop
t—Engineers' Office
u—Blacksmiths' shop
v—Store-house
w—Weighing Cabin
x—Weighing Table
y—General Offices
z—Lamp Cabin

The Beaumont seam, being the next in order, is worked during the day, on the long-wall system. It is a splendid gas coal, and is more suitable for the long-wall method, because it contains a band of from twenty inches to three feet in thickness, which serves for building up the pack-walls, besides a better yield of round coal, and I should say at a less cost for shift work. The main engine-plane and travelling roads, air-ways, etc., are laid out on the board-and-wall system, as shown in plan by fig. 5. A long-wall face being opened out on either side of these pillars, and by experience it has been found that where the band does not exceed two feet in thickness a straight face is best adapted to the working, because a better percentage of round coal is obtained, and the working cost is not so heavy, ventilation is made easier, and the men throw the band back as they go on, special men being sent in, after the hewers have done, to build up the necessary packs. Generally, in opening out a long-wall face, a breast of about 200 yards is taken and carried forward, the mother-gate board or wagon-way being in the centre, and the gate-ways about ten yards apart, and cross-gates about thirty-three yards, or to suit the general conditions met with. Gas is also given off in this seam, but more especially in the neighbourhood of faults. The workings are all to the rise, there being very little to the south on account of the Coaly Hill Dyke, as before mentioned, passing through, besides which the band gets a good deal thicker to the south, and the bottom coal less.

The Brockwell seam, as before mentioned, has been abandoned, but, when working, it was both on the long-wall method and board and wall, the long-wall being on the north side, and the board and wall on the south side, next to the whin dyke. An average quantity of gas was given off in this seam also, the coal not being of such a good quality as the seams above, and a little water was also found to come off in the dip places.

WINDING AND HAULAGE.—The winding engine at this pit is a double-acting single-cylinder vertical and condensing engine, having a plane drum, and fitted with a foot-brake. Diameter of cylinder is 56 inches, or 2463 square inches area, less the area of a six-inch piston rod on one side $= 2463 - 27 =$ 2436 square inches effective area on the piston rod side. Length of stroke is six feet six inches. Average steam pressure is 30 pounds, with about 20 inches vacuum or $9\frac{3}{4}$ pounds. H.P., 383. It has a 19 feet 11 inches diameter drum, and a three-decked cage, having two tubs per deck, and weighing about two tons. Best plough steel winding ropes, $4\frac{1}{2}$ inches in

circumference, which pass over two twelve-feet pulleys, and the engine is counter-balanced by the chain and staple method. The Brockwell winding engine is also one of the same class as the above, but not so large, it being only used now to lift water from the Brockwell seam to the standage for it made in the Low Main seam. The position of this engine on the surface is shewn in fig. 2, the ropes passing down the shaft, in boxes, to the Low Main seam, where they pass over a series of pulleys fixed in the side of the shaft, as shewn in fig. 1, and from thence over pulleys fixed at the bottom of the small pit. This pit serves for an up-cast for the ventilation of both the Brockwell and Beaumont seams, the coals being drawn up it also from the Brockwell to the Beaumont, where they are hung on at the large winding shaft.

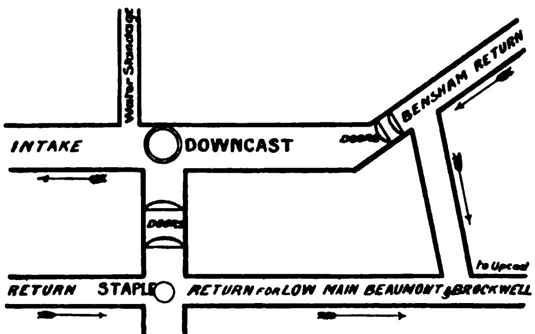



Fig. 3.
**Plan of Portion of Low Main Seam.**

The haulage of Brockwell seam was also done by an engine placed on the surface, but which is now utilised for hauling in the Bensham seam, the position of which is shewn in plan, on fig. 2. It is a double-acting non-condensing engine, with two twenty-inch cylinders, having a two-feet stroke and single-motion blocks. Fly-wheel ten-feet diameter on the first motion. There are four drums to this engine, each six feet in diameter, and fitted with clutch gearing, so that two drums can be geared to the engine at one time. The clutch is worked by a six-feet lever keyed to the shaft of the small arm of the lever actuating the clutch. For each pair of drums there is a 29-inch pinion wheel geared to a six-inch pinion wheel, on whose shaft the clutch is keyed. Strap brakes are on the drums, which are cleated round with metal and worked by the foot. The ropes pass through boxes, through a hopper which is used for the storage of coals, and over two five-feet pulleys and down the shaft, in boxes, to the Bensham seam, where they pass through a proper roadway on to the engine plane. The engine does not draw the sets out on to the bank head as mentioned, and shown in fig. 1, but to a distance of about 100 yards from there, a pony doing the work between the top of the incline and the landing.

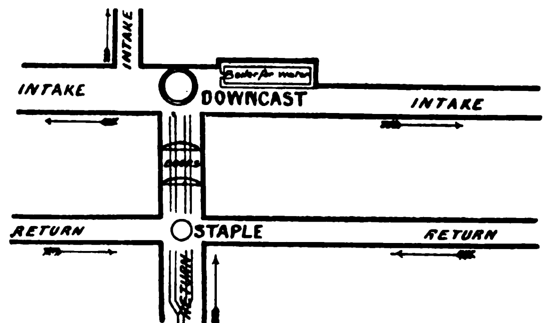



Fig. 4.
**Plan of portion of Beaumont Seam.**

The Beaumont seam haulage is also main-and-tail rope, self-acting inclines being used in some of the branch roads from the face to where the engine is required to draw them from. This hauling engine is also a double-acting non-condensing engine, with two 17-inch cylinders, 22-inch stroke, geared three to one, with a six-feet six-inch fly-wheel. Drums, five feet diameter. The ropes in passing from the engine traverse underneath the heap-stead, over two five-feet pulleys in boxes, and down the shaft to the Beaumont seam, where the tail rope passes over a five-feet pulley, and along some boxes fastened to the roof to the in-bye end of the shaft siding. Then, owing to the shaft siding being in a dish, it comes close to the thill. The main rope is passed round a pulley placed near the bottom, so that the rope is carried through, underneath the flatsheds, in boxes, for about twenty yards, to where it comes out between the roads.

SIGNALLING.—The shaft signalling is all done by electricity, both from the Brockwell and Beaumont seams, besides a telephone being ready and usable at any time, from the latter place to the engine-houses for winding respectively. The old type of signalling—that is: the lever and hammer, is still in use from the Low Main seam to the surface. Engine-plane signalling is also done by the lever and hammer system.

PUMPING is *nil*, except the small hand pumps put up in one or two dip places in the Beaumont seam. All the water is lifted to the surface by means of water-tubs put in the cages. The water, as before stated, is lifted from out of the Brockwell to the Low Main by tubs in the staple, and is then carried from thence to

a boiler placed close to the shaft in the Beaumont seam, as shewn in plan by fig. 4. This serves as a reservoir, and by a connection made with a pipe, and tap fixed on to it, the water is run out and into the water-tubs, which are generally placed in the bottom deck of the cage, and on its arrival at bank it is made to empty itself, by means of levers, into a box or launder, and carried off to the pond. The average quantity of water raised is only about thirteen gallons per minute, so that for a feeder like this a pump is not necessary.


Fig. 5.
Plan of Main North Beaumont Seam.

VENTILATION.—As before stated, a GUIBAL fan is used, a systematic style of ventilation being adopted, all the districts in each of the separate seams having independent intakes commencing from the main in-take, as near the shaft as possible, and the main returns terminating as near the up-cast as they can be got for the whin dyke, but the passage through it is of an enormous area, and after passing it they are again split until the up-cast is reached. The average quantity of air passing through the air-way at the whin dyke, last year, was 120,000 cubic feet per minute.

LAMPS in use are of two kinds. In the Bensham and Beaumont seams the MARSAUT lamp is used, but in the Low Main PATTERSON'S DAVY lamp is used. Open lights are used at each of the separate hanging-on places now, but no naked light or unlocked safety lamp is allowed past the caution board, which is fixed within twenty yards of the down-cast. The heap-stead, offices, engine-houses, and shops are all supplied with the electric light from a small dynamo placed in the engine-house, as shown on plan.—(Fig. 2.) The engine is also used for driving a pug mill for the manufacture of lime, during the day time.

All the coals that are drawn at this colliery are shipped on the Tyne, excepting the small quantity which is taken for land sale, and for the Walker and Wallsend Gas Company's works, which are close at hand, a private branch line running into it. This colliery has no connection to the North-Eastern Railway, or any other line, the coals being all run on their own branch road, which is a self-acting incline, down to the straiths, where they are all shipped, the majority going to the Becton Gas Works, in London. The average daily out-put for 1892 was close upon 1,000 tons per day. The number of persons employed are about 950, both for surface and underground.

## COLLIERY VALUATION.

(COMMUNICATED.)

TO value a colliery is an operation which requires considerable experience and skill, together with a knowledge of the commercial value of coal.

An inventory of the whole of the plant of the colliery, consisting of engines, &c., must be made, and the value estimated, according to other circumstances which must first be considered. It is impossible, without considerable experience of such matters to form anything like a correct estimate of the plant value, for when a colliery is sold as a working concern the plant may be worth far more than its first cost (without erection), if the estimated output of coal be large, and a fair percentage on the present value be probable.

The principal point to be considered is the amount of coal remaining to get in lease, or the probability of extending the area of the lease. This area must be calculated, and, if the whole of the mines are not proved, an estimated thickness of the workable seams must be taken from whatever data may be obtainable, and the tonnage of the area from which the coal is to be got, worked out, a deduction being made for faults. The amount of allowance necessary for faults will of course vary considerably, and the determination of this point must be governed by the nature of the mines already proved, or those in the neighbourhood, and may be anything between five and twenty per cent.

The tonnage of coal remaining to get being calculated, it is necessary to ascertain the quantity of coal which can be got out per annum with present plant, or if it be necessary, an allowance may be made for the erection of new plant or the deepening of the existing shafts or, probably, new sinkings, according to circumstances and the output estimated with the new conditions. For example, it might be stated that the yield would be about 400,000 tons per annum until the expiration of the lease of forty years, providing a further outlay of £40,000 be made.

Another point to be considered is the profit which each ton of coal will yield under ordinary conditions. This must be calculated separately for each mine, as it will vary considerably. A cannel mine of fair thickness or a good seam of coal may yield a profit of several shillings per ton, while that of a thin seam of coal may be only as many pence.

To determine this point fairly accurately, a knowledge of the coal trade is invaluable. The cost of production for each mine must be calculated from working estimates if possible.

The yield per annum and the approximate profit per ton being found, we have the profit per annum. When estimating this profit it is usual to deduct what may be considered as plant depreciation.

Having the profit of the colliery per annum it now remains to be decided what is the present value, if this percentage continues for the estimated number of years. The rate of interest for collieries should be from ten to twenty per cent., it being necessary to have a large rate of interest to compensate for risk and contingencies. It must also be remembered that at the expiration of the term the colliery is practically valueless, so that it is necessary to redeem the capital, as well as secure suitable interest, during the working.

Altogether, colliery valuation is at the best a very fickle question, as even experienced men, recognised as authorities, differ widely in the valuation of the same colliery. This is clearly shown in arbitration cases, where, even neglecting the biassed opinion which some men give for their own side, the valuation of one mining engineer is five times, and in many cases, ten times that estimated by the other. It is a very simple matter which creates a great difference. For example, the question may resolve itself into whether an un-proved mine is workable to a profit or not, and the determination of a decision to a matter of *several thousand pounds* may be dependant *upon the result.*

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# EASY LESSONS ON MINE SURVEYING

**For Beginners.**

*Commenced in No. 2, Volume II.*

## SURFACE SURVEYS.

### Triangulation.

THE process by which surface surveys are made is known as triangulation, and may be trigonometrical, or by measurements alone.

The usual method adopted for colliery surveys is to measure the whole of the lines, and check the angles of the principal triangles with a theodolite. Very accurate results can be obtained in this manner.

As has been previously explained, a triangle is the only figure which ties itself in. To be more explicit: if three lines of definite length are taken in a certain order to form a triangle, the angles contained by the three sides are definite angles, and the three sides cannot form a figure containing different angles. This is not the case with any other figure. For example: two unlike quadrilateral figures can be formed from four sides of a definite length. The reason therefore why the lines of a surface survey are formed into triangles is obvious. The three sides of the triangle are measured, and also a line running from the apex of the triangle to the base, to act as a check, and which is known as the tie line.

In the majority of cases, the form of the survey renders it necessary to form the main lines into two triangles, though, in some cases, it may be enclosed by one. In the former case, the main or base line of the survey is run through the longest part of the estate. A possible example will serve to illustrate this more clearly.

As a simple example, assume the survey to be of a single field with irregular sides, as shewn by the firm lines on plan—(fig. 61).

The longest line which would run through the field is AB, which is therefore staffed out. Next, the lines AC and BC are staffed out as near to the hedge as is convenient for facility and accuracy in off-setting. In like manner staff out the lines BD and DE. The point E is chosen in the line AB from which to run a line to D, for the reason that shorter off-sets will be obtained than would be the case if it were run from A. Also, fix staffs at F and G in the line AB.

The following are the bookings for the figure, commencing at the bottom:—

### Field Book.

| | | | |
|---|---|---|---|
| | F) | (526) | to $\frac{500}{1}$ |
| | | 65 | |
| | (D) | (00) | |
| Tie | | | |

Line 7 (DF) from $\frac{686}{5}$

| | | | |
|---|---|---|---|
| | (B) | (866) | to $\frac{1170}{1}$ |
| 40 | | 724 | |
| 25 | | 630 | |
| 23 | | 555 | |
| 30 | | 512 | |
| 28 | | 430 | |
| 38 | | 300 | |
| 7 | | 260 | |
| 27 | | 155 | |
| 28 | | 50 | |
| | (D) | (00) | |

Line 6 (DB) from $\frac{686}{5}$

| | | | |
|---|---|---|---|
| | (D) | (686) | |
| 13 | | 585 | |
| 6 | | 468 | |
| 18 | | 375 | |
| 15 | | 227 | |
| 31 | | 180 | |
| 42 | | 120 | |
| | (E) | (00) | |

Line 5 (ED) from $\frac{70}{1}$ to east.

| | | | |
|---|---|---|---|
| | (G) | (508) | o $\frac{75}{}$ |
| | | 28 | |
| | (C) | (00) | |
| Tie | | | |

Line 4 (CG) from $\frac{638}{2}$

| | | | |
|---|---|---|---|
| | (A) | (935) | to $\frac{00}{1}$ |
| 52 | | 850 | |
| 45 | | 745 | |
| 18 | | 665 | |
| 11 | | 593 | |
| 15 | | 462 | |
| 4 | | 415 | |
| 26 | | 280 | |
| 46 | | 232 | |
| 48 | | 168 | |
| 22 | | 15 | |
| | (C) | (00) | |

Line 3 (CA) from $\frac{630}{2}$

| | | | |
|---|---|---|---|
| | (C) | (638) | |
| 43 | | 563 | |
| 36 | | 372 | |
| 21 | | 285 | |
| 20 | | 190 | |
| 12 | | 125 | |
| 15 | | 18 | |
| | (B) | (00) | |

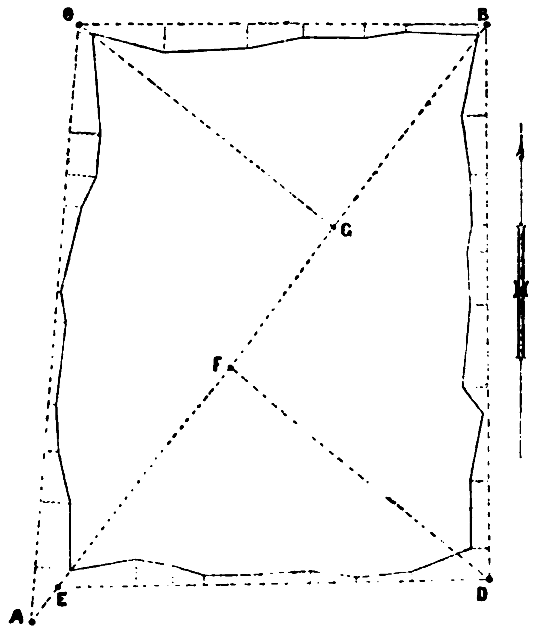
Line 2 (BC) from $\frac{1170}{1}$ to west

| | | |
|---|---|---|
| (B) | (1170) | |
| | 1145 | |
| (G) | (775) | |
| (F) | (500) | |
| | 100 | |
| (E) | (70) | |
| (A) | (00) | |

Line 1 (AB) to north-east

**SURVEY OF FIELD.**

*Gunter's Chain.* *July*, 1894.




*Scale: 3 chains to an inch.*

Fig. 61.

The station measurements are denoted by being enclosed by brackets, and the letters A, B, C, etc., form no part of the actual survey, they being simply put in to show the position of the lines on the illustration.

We have presumed that the whole of the lines are staffed-out immediately before the measuring is commenced. This may be done with advantage in a small survey which requires only a few staffs, but in an extensive survey only the base-line AB would be staffed-out previous to its being measured, and the position of such stations as E F and G must be judged, and marked by driving wooden pegs—about two inches square and fifteen inches long—into the ground. It is often found that where the peg has been left is not the best position for the intended line, in which case a measurement must be made from the peg along the base line to the new station, and the position marked in the book.

It may be taken as a rule that the outside lines of the triangle should enclose the whole of the estate, but in some cases a small elongated portion may be left outside, if expedient, and a small triangle run to it for the off-sets.

To plot the above survey draw any line AB, and make it equal to line 1. Then prick off the stations E F and G. Open the compasses until the width equals the length of line 2 on the scale, and, with one leg at the

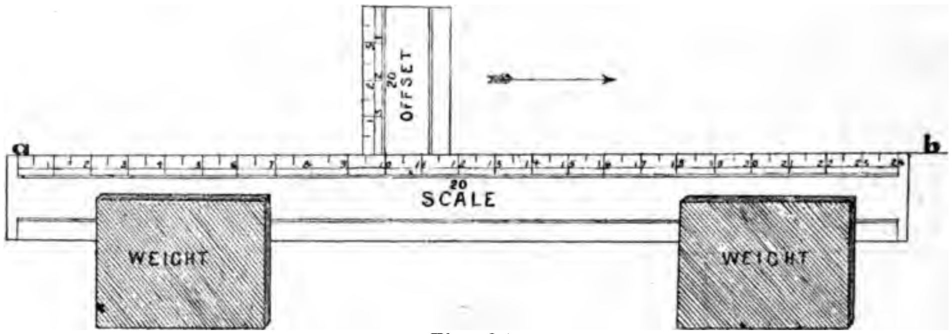



Fig. 62.

point B, mark off an arc about C. Again, take the length of line 3 on the compasses, and with A as a centre, mark off an arc about C. Where the two arcs cut each other is the position of the lines. To test the accuracy of the measurements, take the length of line 4 on the compasses, and, with G as a centre, mark off another arc about C. The arcs should cut each other exactly at the three same point, otherwise some of the measurements are wrong. Next, form the triangle EDB in the same manner, checking it by the tie-line DF.

### Plotting Off-Sets.

For plotting off-sets, small scales marked exactly like the larger scales, though not so long, are used. Fig. 62 shews the ordinary 20 scale and the off-set, the former being made to measure twelve inches, and the latter is exactly two inches in length, the ends being square off and flush with the first division. To plot off-sets the ordinary scale is placed with its edge immediately over the line (*ab*,) and the first mark of division on the scale at the commencement (*a*) of the line. Two metal plan weights are then laid on it, as shown in figure, to keep it in position. The end of the off-set is then brought up to the edge of the scale and pushed along, in the direction of the arrow, to the point on the scale where the off-set is taken. The position, as shewn in sketch, is for an off-set at 94. The off-set is then marked by making a prick-hole immediately against the off-set, the distance from the main line being measured by the off-set scale.

*(To be continued.)*

## COMPETITION QUESTIONS.

To the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d.**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. In accordance with our custom the best answer to *each individual Question* will be published with the sender's name and address.

1.—All envelopes must be marked "Competition."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by July 28th, 1894.
5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—What is meant by scaling the air in ventilation, and how is it applied?

*Question* 2.—Explain, with illustration, what is meant by creep in a mine.

*Question* 3.—Give a brief description of the endless method of haulage.

### ADVANCED.

*Question* 4.—How can compressed air be most economically applied to ventilation.

*Question* 5.—Give sketch and description of what you consider to be one of the best safety lamps.

*Question* 6.—How would you arrange the arching at the bottom of a mine where the strata at top and bottom was soft?

### FIRST-CLASS.

*Question* 7.—Give a brief account of the duties of a colliery manager.

*Question* 8.—Explain, with illustration, how you would arrange for winding at a fan pit.

*Question* 9.—Are the Examinations for First-Class Certificates of Competency, in your opinion perfect? If not, what alterations would you suggest?

*Question* 10.—Shew, with illustrations, how you would work a seam of coal subject to spontaneous combustion?

# EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

*(Continued from No. 16, Vol. II.)*

The following questions for the Examination of Candidates for Certificates (First-class) of Competency were set in the South-Western Division, September, 1892:—

### Subject.—
### COLLIERY PLANT & MACHINERY.

QUESTION 6.—A fan engine works at the rate of 80 revolutions per minute. The cylinder is 18 inches diameter. The stroke is 30 inches, The mean pressure on the piston is 40 pounds per square inch. Work out the theoretical horse-power of this single-cylinder engine.

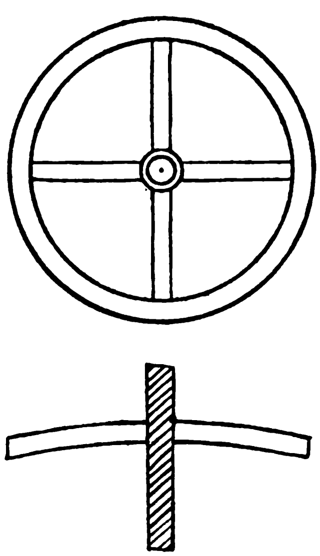
ANSWER.—$18^2 \times \cdot 7854 = 254\cdot 4696$ area of cylinder

$2\cdot 5 \times 2 \times 80 = 400$ speed in feet per minute

40 pounds pressure of steam.

$$\therefore \text{h.p.} = \frac{254\cdot 4696 \times 400 \times 40}{33000} = \underline{\underline{123 \text{ H.P.}}}$$

QUESTION 7.—Sketch, in ink, a good form of foot-valve for a pump, and explain its use.



**Foot Valve and Seating.**

ANSWER.—A foot-valve is attached to lower length of suction pipe, its use being to keep the pipes and cylinder charged with water, and also prevents the pump, on being started, from having to free both itself and the suction pipes from air.—(See sketch.)

QUESTION 8.—If you had to provide an engine to pump 8000 gallons of water per hour up a vertical shaft which was 150 yards deep, what horse-power would you think it necessary for the engine to be capable of developing in regular work?

ANSWER.—8000 gallons of water per hour. $\therefore 8000 \times 10 = 80000$ pounds of water per hour. $80000 \div 60 = 1333\cdot 5$ pounds of water per minute. Depth of shaft $= 450$ feet.

$$\therefore \frac{1333\cdot 5 \times 450}{33{,}000 \times \cdot 7} = \underline{\underline{26 \text{ horse-power, nearly.}}}$$

Modulus of engine $= \cdot 7$.

QUESTION 9.—What are the advantages and disadvantages of employing compressed air on a large scale, as a means of obtaining power in mines?

ANSWER.—The advantages of using compressed air underground are:—(1) Can be carried to any point in the mine with safety. (2) Does away with the evil effect of steam and exhaust of engine. (3) Is beneficial to the ventilation of the mine, because the exhaust air from the engines in use not only adds to the ventilation but has a tendency to cool the same, and therefore does not affect the roos of the mine as steam does.

Disadvantages are:—(1) The great loss of power which it entails in its use, because taking into account the amount of the work performed in the steam cylinder of an air-compressing engine we do not get back, on the average, more than one-fourth or one-third of this work. (2) Large plant on surface, which means a very heavy expense, and this combined with the great loss of power, its general adoption has been retarded.

The two great losses in the use of compressed air are:—(1) The loss of heat which passes on compression. (2) The effect of the heat on the air in the air-cylinder.

QUESTION 10.—Describe and give ink sketches of a good pit cage, and explain how the bridle chains are arranged and connected.

ANSWER.—A good pit cage should be made of steel, the size according to size of shaft and quantity of material to be raised. I will describe a two-decked cage to hold one tub in each deck. This consists of four uprights made of forged steel; deck frames and cross bearers of auger steel, the cross bearers to have knee-ends which are rivetted to the frame. The floor of each deck to be of perforated steel. Each deck to be lined with sheet-iron, and an iron crown on the top of the cage to prevent anything falling on the men whilst ascending or descending the shaft. The bridle chains—four in number—are attached to the cage hangers—one to each hanger, and these chains are suspended from a large link, which is coupled at the end of the rope by a D-shackle.

*(Sketches in No. 14, Vol. II.)*

N.B.—In next issue will commence Questions given in the West Lancashire and North Wales District, in June, 1893, for Mine Managers' Certificates. Answers by J. CARTER.



**Colliery Explosion near Pontypridd.**

WE are sorry to learn the enormous number of lives first supposed to be lost at this explosion has been exceeded. It is unnecessary for us to give an account of this sad affair, as the whole is recounted in the daily papers. We may, however, remark that H. HALL, Esq., H.M.I.M., states that the dust from this colliery is of the most fiery character.

## RECENT IMPROVEMENTS IN MINING MACHINERY & APPLIANCES

BY

MR. WM. SAINT, H.M.I.M.

(Address read before the Manchester Geological Society.)

*Continued from last issue.*

### LIGHTING.

Almost all the principal collieries are now provided with installations of the electric light for illuminating the surface works and the main roads, etc., in the vicinity of the bottom of the winding shaft. It compares favourably with coal gas as regards illumination, cost, and immunity from risks by fire. Its use is very desirable in the neighbourhood of coal screens and picking belts, where large quantities of fine dry dust are always present in the atmosphere. Where gas is used in such situations it is desirable for purposes of safety to burn it in lamps fed with pure air.

Attempts were made four or five years ago to introduce, as a substitute for oil safety lamps, portable secondary batteries with electric incandescent lamps, giving a light of 1½ or 2 candle power for 8 to 12 hours; but their success was marred through leakage of the solution of sulphuric acid which they contained, causing corrosion and short circuiting, and by the difficulties in charging them with electricity from the dynamo. They have not come into general use, and we are therefore still dependent upon the principle discovered by Sir Humphrey Davy as the basis of security in our safety lamps. The improvements consist mainly in the provision of a glass, duplication of gauzes, and in surrounding the gauzes with a metal shield to protect them from the force of the air currents. By an ingenious arrangement for admitting the air into the body of the lamp the light has been improved. The lead rivet lock is now commonly used, and it possesses the merit of great simplicity with the certainty of detection in the case of tampering. Some of the modern lamps have attained a high degree of perfection as regards safety, but a lamp absolutely safe under all conditions has yet to be invented.

Owing to the difficulty of detecting the presence in the air of less than 2½ or perhaps 2 per cent. of gas with the ordinary safety lamp, and lesser proportions having been proved to be an element of danger in the presence of coal dust during blasting operations, attempts have been made with success to invent more delicate indicators for the use of officials and shot-lighters.

The Liveing indicator essentially consists of two coils of platinum wire connected to a small electric battery. One coil is enclosed in a glass shield and protected from contact with the atmosphere to be tested, and the other in a shield of glass and wire gauze which admits the air. A moveable photometric screen and fixed scale are placed between the two spirals. When the electric current is applied and the indicator is in pure air both spirals glow equally; but in presence of firedamp in the air the exposed one glows more brightly and the screen is moved until its sides are equally illuminated, and the position on the scale indicates the percentage of the gas.

We have also the Peiler safety lamp burning pure alcohol, and Ashworth's lamp burning benzoline. Both these lamps are designed for the purpose of detecting small proportions of firedamp in air—the former being the most sensitive.

A short time ago, Dr. Clowes introduced to public notice his inflammable gas detecter. It consists in the addition of a hydrogen flame within the ordinary safety lamp. A small cylindrical vessel containing hydrogen is attached to suitable external fittings of the lamp, and connection is made with a tube which terminates near the ordinary burner. By turning a tap the hydrogen is allowed to enter the lamp and it is ignited by the oil flame, which is then extinguished by pulling down the wick. The hydrogen flame is regulated to a standard and the lamp is ready for testing purposes. The oil flame can be re-lit by the hydrogen flame, and the latter extinguished, when the lamp may be used in the ordinary way. It is claimed that one-fourth per cent. of firedamp in air can thus be detected with certainty.

More recently Mr. A. H. Stokes, one of H.M. Inspectors of Mines, has designed a similar arrangement to that of Dr. Clowes' hydrogen lamp. Instead of hydrogen he uses pure alcohol, fed by a small wick which, in conjunction with a peculiar wick tube, regulates the size of the flame. It is thus a combination of the ordinary safety lamp and the Pieler lamp in a very handy form.

These delicate indicators should only be used where the ordinary oil flame fails to reveal the presence of firedamp as they are very sensitive and require much care in manipulation.

## COAL DUST AND ITS TREATMENT.

The presence of dry coal dust constitutes an element of danger in mines where blasting is carried on without special precautions. Its sensitiveness to ignition can be demonstrated in the most graphic manner on the surface by simply exploding a charge of gunpowder in its midst. It is therefore desirable to prevent, so far as possible, accumulations of dry dust, or that some means for rendering it innocuous should be adopted. To this end various methods of water have been tried with varying success. The fine water spray which originated with Mr. J. J. Thomas, manager of the Ynishir Colliery, and known as the South Wales system is largely used. It has been successfully introduced into most of the steam coal collieries in South Wales. Filtered water under great pressure—in some cases exceeding 600lbs. per square inch—is carried in pipes along the main haulage roads. At intervals stand pipes are fitted, terminating in spray nozzles. The spray is discharged in the opposite direction to the ventilating current; this tends to break it up, and it is then carried in the air and distributed on the roof, floor, and sides, over a distance varying from 15 to 40 yards, according to the velocity of the air current.

The method introduced by Mr. H. W. Martin, at the Dowlais Collieries, produces a more perfect spray. A jet of compressed air being introduced into the spray nozzles with excellent effect.

This system effectually lays the dust, cools the atmosphere of the mine, and makes travelling more agreeable. It also tends to save haulage power and wear and tear of the tub axles. Similar arrangements have been introduced at a few of the collieries of Lancashire, but only with partial success, which I am disposed to attribute to the use of unfiltered water, insufficient pressure, and to the slower velocity of the ventilating currents as compared with those in the South Wales mines.

Much can be done to prevent accumulation of dust in the haulage roads by using good rolling stock, kept in a thorough state of repair, and by removing it from the roads at frequent intervals. When wooden tubs are used the boards should be tongued and grooved—a method satisfactorily adopted a few years ago by Mr. J. S. Burrows, at the Atherton Collieries. It is also an improvement to have the roads laid with long fish-plated rails, resting upon iron or steel sleepers, in order to prevent the tubs leaving the rails and spilling their contents.

## BLASTING.

In sinking pits the old method of drilling by hand still continues, but in the coal mines the shot holes are now generally drilled by machine drills worked by hand. They lessen the labour and enable the boring to be done expeditiously.

The introduction of Mr. Miles Settle's device for surrounding the explosive with water and of various compounds, such as roburite, which in themselves contain flame extinguishing elements, together with electric firing, has enormously decreased the risks of mine explosions through blasting. The use of electric fuses has been extending for several years, and undoubtedly affords the best and safest means of igniting explosives. Ordinary powder fuse sometimes hangs fire for hours, and consequently there is danger in approaching a "missed shot;" but with electric fuses, as now manufactured, it is claimed that they cannot possibly hang fire. Good portable electric batteries are now supplied at moderate prices. They are of two kinds, namely, high and low tension, and fuses are made to suit each system.

*(Concluded.)*

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Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.
Correspondence must not be enclosed with Competition Answers.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### MATHEMATICS.

Sir,—How much water does a 16-feet circular shaft, 500 yards deep, contain, and what is the pressure of the water if it weighs 30 pounds per cubic foot?

"MINING PROMOTER."

### DYNAMITE.

Sir,—In your issue of "Mining" for June 2nd, No. 14, Vol. II, appears an answer to the question:—"Of what is dynamite made, etc.?" I like your winner's answer very much, with the exception of the sentence "and it has a tendency to strike downwards." Perhaps Mr. COOK or some other of your readers would kindly explain this sentence. Trusting Mr. COOK will not think that I am trying to find fault with his answer, but only seeking for information.

YOUNG STUDENT

Sir,—Will any of your many readers please instruct me the easiest method in ascertaining the following questions:—

1. There are two mines dipping 1 in 5, and they are 76 yards apart, a tunnel rising 1 in 5. What is length of tunnel?
2. What is the weight of coal in $1\frac{1}{4}$ statute acres, 4 feet thick, 18 cwt. to a cubic yard?
3. A loaded tub weighing 10 cwt., standing on a level, takes a pull of 25lbs. to start it, what pull will be required to start it up an incline of 1 in 20.
4. The area of a square field being 3 acres 0 roods 20 poles, 16 yards statute measure. What is the length of one side in yards.

Yours truly, OVER HULTON.

## ANSWERS TO CORRESPONDENTS.

D.L. (Dalton-in-Furness)—You are quite right in saying that there is an error in No. 10, Vol. II., and as you say you do not want such a valuable book of reference as "Mining" to be unreliable, you wish us to correct it, and you apologise for calling our attention to it. Now apologies are altogether unnecessary, insomuch that the Correspondent earns our thanks, and we sincerely hope that readers will call our attention immediately to any error that may occur. Despite our utmost endeavours, errors will occur, though we have been particularly fortunate in this respect in the past, and hope to continue so. The error which you refer to was, however, corrected in No. 12. Nevertheless, we owe you our thanks.

F.N. (Derby)—We think that descriptions of some of the collieries with which our readers are acquainted, with illustrative details, would be very interesting, and we shall publish and pay for such, if we consider them of sufficient merit.

*Printed and Published* by STROWGER AND SON Clarence Yard Wallgate, Wigan.

# MINING
A JOURNAL DEVOTED TO THE INTERESTS OF MINING STUDENTS.

Vol. II. SATURDAY, JULY 28, 1894. FORTNIGHTLY. ONE PENNY.

## CONTENTS.



## Y LESSONS ON MINE SURVEYING

**For Beginners.**

*Commenced in No. 2, Volume II.*

### URFACE SURVEYS.—(CONTD.)

E accompanying illustration (fig. 63) of an assumed estate shews the order, position lirection of the lines which would probably in to survey it.

hen an estate is to be surveyed the first to do is to obtain an existing plan of it ssible. In this country the Ordnance plan fficient for the purpose. The boundary e estate is coloured on this plan, and the ion of the main lines marked on in what ars the best position. Only the main of the triangles and the tie lines are ed, the inside work being filled in, ding to circumstances, on the ground .

r example, having the six-inch-to-a-mile iance sheet of the estate shewn, then it d be perceived at a glance that the best iod of surveying it would be to divide it two triangles, and the position of line 1 is ed in a somewhat similar position to that n. The position of lines 2, 3, 4, 24, 25, 26 are also marked.

If it so happens that a previous plan of the estate cannot be obtained the fixing of the main lines becomes more difficult, and their position is determined by walking over the estate and thus acquiring sufficient data from which to make a rough sketch plan, when the lines can be laid out as before.

Next commences the actual survey. Line 1 is staffed out and measured, the line being terminated at both ends by the appearance which the land presents for running the lines 2, 3, 24, and 46.

When measuring the first line of the survey it would be apparent that stations were required for the following lines:—3 and 46; 8, 39, 11, 13, 40, 20 and 30; 21 and 32; 31, 22, 28, 23 and 27; and 2 and 4; and pegs are therefore left in the most likely position. The probable position of the lines 25, 4, 26 and 29 could not be determined very accurately when measuring line 1, so no stations would be left for these lines, and the point of line 1 which they run to is determined by measuring to the nearest station on the line. For example, when line 25 is staffed out it is found to come between the two first stations of line 1. Staffs are fixed up at these stations and the point where line 25 cuts line 1, lined off, and the distance is determined by measuring back from the second station and deducting this length from the length of the second station on line 1.

The order of the lines is shown by the number enclosed by the concentric circles, and their direction by the arrow head. The small circles on the lines represent stations. It will be noticed by the order of the lines that the two lines necessary to complete the triangle on the north side are done first, and next the tie line, succeeded by the inside filling-up lines. The filling-in of the inside work is comparatively easy if stations have been left on the

main lines in their proper position. When doing the filling-in it should be commenced in one corner and worked progressively before you so that no lines are missed. The triangle being fully completed, the main lines of the other triangles are measured, and the filling-in proceeded with as before. The method of running the lines requires no further explanation if we might except numbers 18 and 19. These lines are set off to form a triangle with the base line 17, and off-sets are taken to the pond. The two lines will form a correct figure when plotted, if the measurements, etc., are correct, but there is nothing to check them. The two lines are generally considered sufficient for getting off ponds, but for an important object a tie line should be run from the junction of the lines 18 and 19 to some fixed point on line 17, to act as a check in the same way as the tie line of the main large triangles, or, in the instance shewn, line 18 might be produced on to line 1, when the work would be properly checked.

The following information will be found valuable for surface surveys:—When off-setting buildings it is sufficient to take two off-sets to each block at the extremities if the corners of the buildings form a right angle, but if they are of irregular shape more off-sets must be taken. The details of the buildings are afterwards got off by taping.

Buildings of masonry or brickwork are denoted on the plan by crossing with parallel lines. Churches and somewhat similar edifices are crossed by two sets of parallel lines drawn at right angles to each other. Greenhouses and other buildings with glass roofs are also crossed by two sets of parallel lines, but the lines are further apart. Wooden buildings are shewn by crossing with parallel dotted lines. Hedges are shewn by a firm line; wooden or post and rail fences by dash and dot lines, thus:— - — - —. Ditches, the edges of grass plots such as the side of a country road, an imaginary line for the boundary, and, in fact, anything not strictly defined, are shewn by

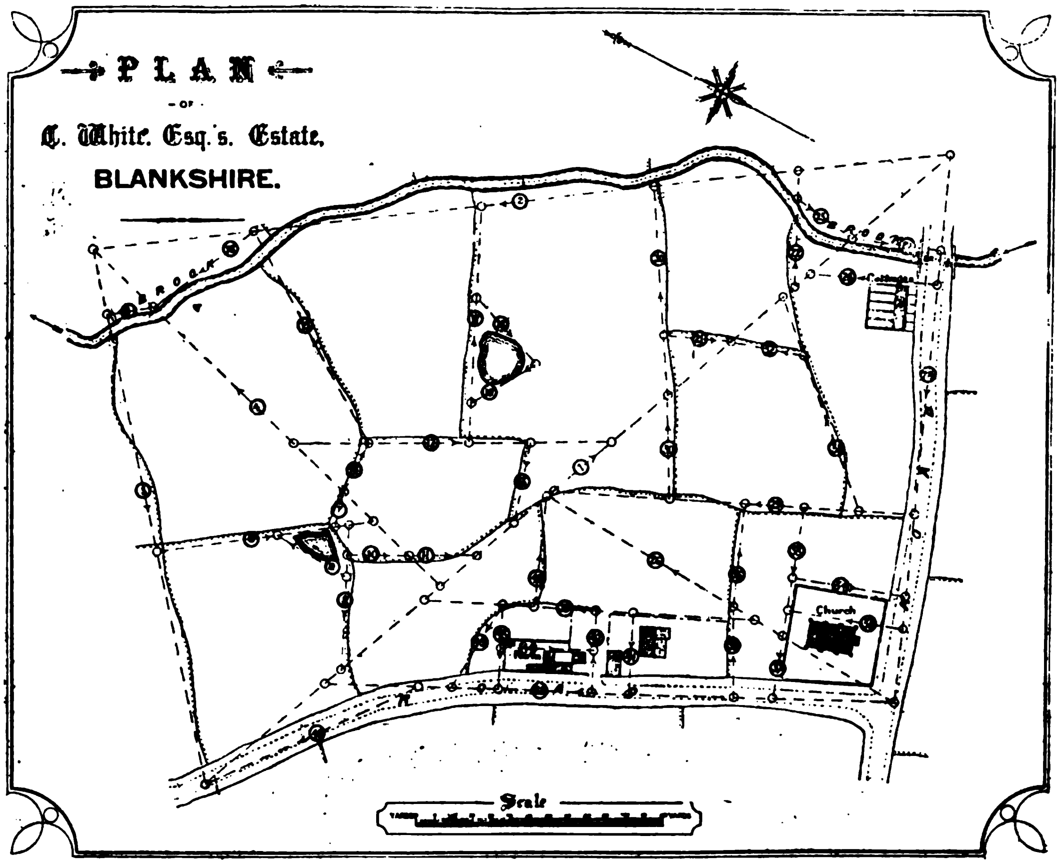


Fig. 63.

dotted lines. The edge of a parapet or kerb-stone is shown by line formed of a dash and two dots alternately, thus :— - - — - - —

Off-sets are taken to the stump of a hedge, but the ditch is the recognised boundary, and the assumed position for the ditch by surveyors in this country is five links from the fence, on the side of the fence the ditch exist.

It is, therefore, important when off-setting a hedge to note in the field-book the side on which the ditch lies, and if it crosses to the other side a note must be made and the point of crossing off-setted. The centre of a brook is also an accepted boundary, but no matter whether there be a hedge alongside or not, the centre of the brook is off-setted, and the width taken at intervals. When an estate borders on a road the boundary is taken to the centre of the road, if not otherwise specified.

(*To be continued.*)

# MURTON COLLIERY,

## DURHAM,

By G. A. HAWES.

(With Illustrations.)

*Specially prepared for "MINING."*

THE first ground was broken on the 19th of February, 1839, for the sinking of the first shaft. Two months later another shaft was commenced, and the sinking carried on simultaneously with the prior shaft. These two shafts have a diameter of fourteen feet. The sinking proceeded somewhat rapidly till the quicksand, or what is geologically termed the "yellow sands," were encountered on the 26th of June, 1839, when a stratum of strong limestone of about four feet in thickness intervening between the working and the quicksand was blown out with prodigous force by the pent-up power of the confined sand. The shaft was immediately filled with a deposit of sand ten feet in depth, choking the pumps then in operation, and eventually stopping all sinking operations for the time being. The stratification overlying the "yellow sands" was found to be as follows :—

| | Fhms. | Ft. | Ins. |
|---|---|---|---|
| Soil, gravel, and strong blue clay | 7 | 4 | 9 |
| Soft marl, massed with beds of craggy limestone .. .. .. | 48 | 4 | 9 |
| Strong brown limestone .. .. | 19 | 0 | 0 |
| Soft blue metal .. .. .. .. | 0 | 2 | 6 |

Very small quantities of water were encountered, indeed, nothing but small surface drainages, till the sinking reached the depth of 39 fathoms, where feeders of water of considerable magnitude were encountered, percolating from the limestone. The necessary pumping plant was erected for dealing with these feeders, the sinking proceeding to the sand, with the result above mentioned. The outburst of water from the sand was terrific, amounting to 3285 gallons per minute. To oppose this formidable enemy the spirited proprietors at once proceeded to arrange for the erection of the necessary plant for pumping off from 3000 to 4000 gallons per minute. But the waters still increased, and doubled and trebled the former quantity, and finally other means had to be resorted to in order to keep the flood down, by which a steam power of an aggregate power equivalent to 1548 horses was brought to bear upon the waters. The second shaft, which was then in close proximity to the sand, was penetrated by several large boreholes to the sand, thus enabling more engine power to be applied. This did not answer, and no sensible impression was made upon the water. Another shaft was commenced and the sinking rapidly pushed forward and in six months' time the shaft had attained the depth of 76 fathoms, or close to the sand. This shaft was completed with walling, metal tubbing, brattice, pumps, cisterns, and all arrangements for pumping a large quantity of water. This shaft had applied to it alone an unprecedented engine power, perhaps never before or never since applied to one shaft, in the shape of two pumping engines and two winding engines, also constructed to pump. The engines in the shaft were set to work simultaneously with the pumps of the other two shafts, and the waters were gradually gained upon by the pumps, which delivered to the surface 10,000 gallons per minute.

Mr. BAILES says "the total amount of engine power thus brought into action was as follows :—

| | |
|---|---|
| Three pumping engines of 350 h.p. each | 1050 h.p. |
| Two winding engines also employed in pumping .......................... | 260 ,, |
| One winding engine also employed in pumping .......................... | 100 ,, |
| Two winding engines for drawing stone, of 25 h.p. each .................... | 50 ,, |
| One winding engine for drawing stone | 18 ,, |
| Total....... | 1478 h.p." |

To generate the enormous amount of steam to maintain this engine-power 34 boilers were required. When all the engines were working they put into motion 27 columns of pumps—18 columns of 19½ inches and 9 columns of 16 inches. Owing to the scrubbing effect of the mixture of sand and water upon the

leathers of the pump buckets, they were found to want very frequent renewal. Indeed, it is stated that they were worn off at the end of from two to three hours. The contractor found it most convenient to have all the leathers renewed at one time, so as always to have the full amount of power applied at once. The wearing of these leathers was indeed an expensive item in this sinking, several tan-yards being employed to supply the enormous demand. Ultimately the feeders were stopped, and successfully kept back by metal tubbing of from $\frac{3}{4}$ of an inch to $1\frac{1}{4}$ inches in thickness. After having successfully passed through the sands the two original shafts were carried down to the coal seams of the district. The Hutton seam, which is the lowest seam working, was won at the depth of 248 fathoms, on the 15th of April, 1845. The third shaft, with a diameter of 16 feet, was then commenced and sunk to the Main coal. The shaft was further carried to the Hutton seam with a smaller diameter of 14 feet. Thus ended the winning of a colliery which cost the enterprising speculators between £300,000 and £400,000.

### Geological Characteristics.

Perhaps a few remarks anent the trouble-some strata called the "yellow sands" would not be out of place here. The sands constitute a perfect subterraneous lake, of variable thickness, throughout the eastern portion of the County of Durham, it being 30 feet at Murton, 3 feet at New Leaham, 96 feet at Byhope, and entirely absent at Monkwearmouth. That the sand has proved an expensive item in the sinking of the collieries on the east coast is easily seen in the sinking of Murton and various others, a sinking at Haswell having to be entirely abandoned on this account. The peculiar geological phenomena characteristic of the magnesian limestone or permian, known as "breccia gashes" or limestone caverns, were found to be abundant in the penetration of the limestone, the sinkers asserting that the caverns were, in some cases, so large that they could walk up them for nearly a quarter of a mile.

### Mode of Working.

The colliery is at present working three seams, viz.:--(1) The Main coal, at the depth of 210 fathoms, with a thickness of six feet of clean coal, and a foot of "splint" or hard coal underlying. The seam is worked exclusively by the board and pillar system. (2) The Low *Main seam*, with a variable thickness of from 3 feet 6 inches to 4 feet of clean coal, is worked by two systems of longwall, viz:—longwall advancing and the longwall pillar modification. The longwall pillar modification (fig. 1)


Fig. 1.

might be termed by the American phrase a "half-caste" between the board and pillar and the longwall systems. The districts are won out by driving what is termed a "big jud" or "mother gate" into the solid coal. At intervals of every 44 yards minor gate-ways are turned away at right angles to the "mother gate." From these gate-ways juds are turned away at each side which go to meet the juds of the gate-way below and the juds of the gate-way above half-way (22 yards). When one jud is driven to its extent or holing, the workman requiring another jud goes to the gate-way and wins for himself another jud, and so on. These gate-ways are all secured with a 9-feet pack, and chocks are set at the tail end of each jud as an extra security, the chocks being erected by timber extracted by the drawers. (3) The Hutton seam is 248 fathoms from the surface, and has an average thickness of 5 feet of clean coal. It is worked by the board and pillar method.

### Quality of Coal.

The quality of coal in the Main Coal seam is pretty good for all-round purposes. The Low Main seam yields a good steam coal, being somewhat of a brittle nature. The Hutton seam yields the very best gas and house coal in the county.

*(To be continued).*

# EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

WEST LANCASHIRE & NORTH WALES DIVISION (JUNE, 1893).

## FIRST CLASS.

INSTRUCTIONS TO CANDIDATES.

**1.—During the Examination the Candidate must not speak to any other Candidate, or hold any communication with him, nor must he leave the room until he has completed his paper, nor then without the permission of the Secretary.**

**2.—Answers must be written on the paper supplied. Each sheet be signed at the foot with the name of the Candidate. The Candidate is not required to answer all the questions, but he must show a competent knowledge in each subject. Answers must be written on one side of the paper only.**

**3—All papers handed to the Candidate must be returned, and no Candidate is allowed to take away with him a copy of the questions, or any of them.**

PRELIMINARY.

**State your age, name, and address.**

### Elementary Education & Ventilation.

QUESTION 1.—What is the weight of water in a range of pipes 7 inches diameter and 120 yards vertical height? State the pressure at the bottom of stocks.

ANSWER.—$7^2 \times \cdot 7854 = 38 \cdot 4846$ area of pipes in inches.

$120 \times 3 \times 12 = 4320$ vertical height in inches water has to be risen.

Therefore, $\frac{38 \cdot 4846 \times 4320}{277 \cdot 274} = 599 \cdot 59$ gallons.

Again, $599 \cdot 59 \times 10 = 5995 \cdot 9$ lbs., $\therefore \frac{5995 \cdot 9}{2240} =$ 2 tons, 13 cwt., 2 qrs., 3·44 lbs., weight of water.

Pressure at bottom of stocks $= (120 \times 1 \cdot 3)$ $= 156$ lbs. per square inch.

QUESTION 2.—In a mine ventilated by a fan the quantity of air produced is 150,000 cubic feet per minute, with 2·5 inches water gauge. If speed of fan be increased by one-third, what will be the effect on the volume of the air and on the water gauge? Show calculation.

ANSWER.—The quantity of air varies as speed of fan, therefore if speed of fan was increased one-third we should have the following: $(150{,}000 + \frac{1}{3}) = 200{,}000$ cubic feet of air. Pressure increases or decreases as square of velocity, therefore $150{,}000^2 : 2 \cdot 5 :: 200{,}000^2 :: 4 \cdot 4$ water gauge. So that if fan speed was increased by one-third the quantity of air would be 200,00 cubic feet. W. G. would be 4·4.

QUESTION 3.—State the laws relating to the friction of air in mines.

ANSWER.—The following are the principal laws with regard to friction of air in mines:—

1. The friction increases or decreases in the same ratio as the rubbing surface increases or decreases. The rubbing surface depends upon the circumference or perimeter of the airway, and its length.

2. Pressures vary as the square of velocities, and velocities vary as the square roots of the pressures.

3. The quantities vary as the cube roots of the powers, and the powers vary as the cubes of the quantities.

QUESTION 4.—What is the weight of coal in an estate of 22½ statute acres, the coal being 3 feet 6 inches thick, and its specific gravity 1·3?

ANSWER.—$\frac{22 \cdot 5 \times 4840 \times 42 \times 1 \cdot 3}{48} =$ 123873·7 tons.

QUESTION 5.—On the accompanying plan of a fiery mine, mark the ventilation and the furnace and dumb drift.

Plan not published.

*(To be continued.)*

## ANSWERS TO QUESTIONS.

### In No. 15, Vol. 2.

### ELEMENTARY.

*Question* 1.—What circumstances are to be considered in determining the length of the stalls in long-wall working?

*Answer*.—The length of the stalls or working face will depend upon the thickness and nature of the coal seam. If the seam was tender, the best plan would be to have the stalls, say, from twenty to thirty yards in length, which would facilitate the putting of the coal on to the gob roads, and, if the working face was daily carried forward under a fresh roof, this plan might be applied with advantage. In the long-wall method the coal may be won by driving roads to the boundary and working towards the shaft, leaving the goaf behind, or by commencing near the shaft and removing the whole of the seam, only leaving sufficient coal to support the shaft. The roadways have to be supported through the goaf with pack-walls or timber. Several modifications of longwall are adopted, and they will vary according to circumstances. The advantages of long-wall working are simplicity of plan, and also of ventilation. Most of the coal can be won with a greater percentage of round coal than by the pillar and stall method.

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*Question* 2.—How is a mine upon a lode laid out for working?

*Answer*.—The shafts are generally sunk on the underlie, and occasionally on the lode, to the depth required. Levels are driven out at intervals of ten or twelve fathoms, and winzes are sunk or rises are cut through, at convenient distances, for communication; they also serve for ventilation. The levels are secured with Norway or larch timber, in sets of three, placed from two to three feet apart and planked over, and the sides are wadded with spiles. The winzes or rises are secured in many instances with half-round timber, in sets of four, notched at the ends. These are placed from three to four feet apart, according to the nature of the ground. The sets are supported at the corners with straddles or punch props, and spiles or planks are put in behind to keep out any loose material. In tender ground the sets can be placed close together. The ground between the winzes is called a stope, and is worked by the method of underhand or overhand stoping. In the underhand method the ore is worked in lifts, commencing at the top of the stope, and the ore and addle are sent down to the level below. In the overhand method the stope is commenced at the bottom, and the ore is worked off in lifts successively. The ore is sometimes sent down to the level below, and in some cases is left in the stalls, the addle or deads being generally left in the gunnies. When stoping in moderately hard ground the sides of the vein may be secured with props or stemples fixed at right angles to the hanging wall. A hitch is cut in the foot wall for the lower end, and the upper end rests against a head board to support the hanging wall. In tender ground long baulks of timber are put in, called stringers. These are stretched at the ends and middle, and lagging or planks are placed behind, which prevents any loose material from falling on the workmen. In some instances passes are left open, and built up with stones when available, or secured with timber. These are the general principles to be observed, and will vary according to circumstances.

---

*Question* 3.—Define the terms fault, throw, hitch, and heave, as used by miners.

*Answer*.—FAULT.—Any sudden change of position as slips, slides, dykes, throws, balks, swellies, nips, heaves, hips, &c., are known as faults, any dislocation or interruption which breaks the continuity of a seam or bed of strata is most properly termed a fault, and in this sense is always applied by geologists. The cause to which faults are generally ascribed is the cooling of the earth, the result of which is a crumbling or folding of the earth's crust, causing fissures or rents in various parts.

THROW.—In working a coal seam you find it suddenly terminate on reaching a fault, and you have to seek the continuation on the other side of the fault at a higher or lower level, and the fault is termed an up-throw or down-throw as you have to rise or descend.

HITCH is the term applied to a small rise fault, when the displacement does not exceed the height of the seam, and when fixing bearers or wallplates in the sides or ends of a shaft, or fixing steel pieces or stemples in the sides of a lode or vein. Thus, the end-hold or lead, as the case may be, is termed a hitch.

HEAVE is the term applied to a horizontal displacement of a bed, vein, or fault. Thus, when driving in a lode and a cross-vein is reached, you cut through it and find that the lode is not at the other side. The lode is then

said to be heaved, and you have to drive on the cross-vein to find the lode. If the lode is found by driving to the right on the cross-vein it is called a right-hand heave; if to the left it is called a left-hand heave. Right-hand heaves are predominant in most mining districts. The displacement varies from a few feet to sixty or seventy fathoms, and are a source of annoyance and expense in mining operations.

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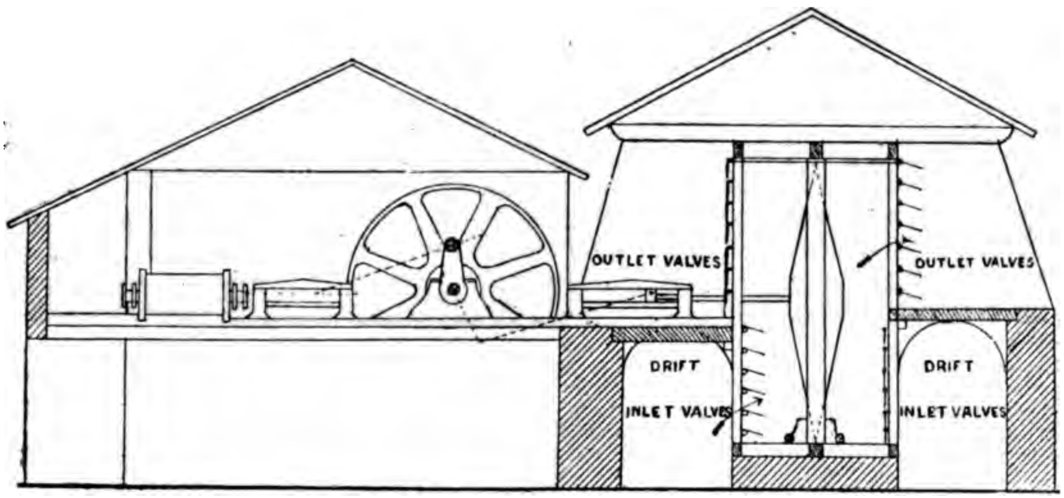
### ADVANCED.

*Question* 4.—Describe NIXON'S ventilating machine.

*Question* 5.—What is cannel coal, and under what conditions is it generally found?

*Answer.*—Cannel coal is composed of carbon, oxygen, nitrogen and hydrogen, in the following proportions:—Carbon, 84 %; hydrogen, 6 %, oxygen and nitrogen, 10 %. This variety of coal is used chiefly for gas making. It is a compact coal of black colour, and being of a very hard and compact character does not soil the fingers when handled. The miners who get or hew this coal, when bituminous coal is absent, return from work almost as clean as they went to work. Cannel is sometimes cut and carved into ornaments. It kindles readily, and burns freely and quickly. It is supposed




**Nixon's Air Pump.**

*Answer.*—NIXON'S type of ventilating machine is one of the reciprocating machines—nothing more or less than an air-pumping machine, of which the accompanying diagram shews the principle in its simplicity. It will be seen that there are two in-take galleries connected to the air pistons, one on the right and the other on the left. There are also to be seen two outlet sets of valves or shutters, the arrows pointing the direction of the flow of air in and out of the piston, the air being admitted alternately on the right and left hand sides at the bottom of the diagram, and expelled alternately on the right and left hand at the top of the diagram. The piston runs on wheels fitted very rigidly, the wheels running in grooves which are cut into the cylinder, this action keeping the piston from rubbing the cylinder bottom. The recriprocative action is given by a horizontal engine having a direct motion from the engine crank, as will be seen in the diagram.

to be of sub-aqueous origin, the roof covering the cannel seam being full of fossil shells and fossil fishes, and forms what may be termed a fish fossil conglomerate.

It is generally found in saucer-like layers thinning out at the edges. There is very much evidence in the Yorkshire cannel field to prove that cannel is of a sub-aqueous formation. First, the coal itself breaks in a shell-like form. Second, there are small shell-like fossils in the coal. Third, in the roof and dirt over and under the coal there are to be found large fossil fish, varying in length from a few inches to many feet. Then lastly, there is the famous cockle-bed roof which seems to be composed of nothing but mud and shells.

---

*Question* 6.—Describe, with illustrations, the operations of getting coal in a longwall working.

*Answer.*—Longwall or widework may be stated as any system whereby the whole seam is removed in one operation, allowing the strata above to settle by degrees on the packs, which are kept up, advancing as the coal face advances. This method of working is subject to many modifications; hence its being adaptable to the winning of most seams of coal, and in almost all the coalfields, especially those of Yorkshire, Lancashire, and Derbyshire.

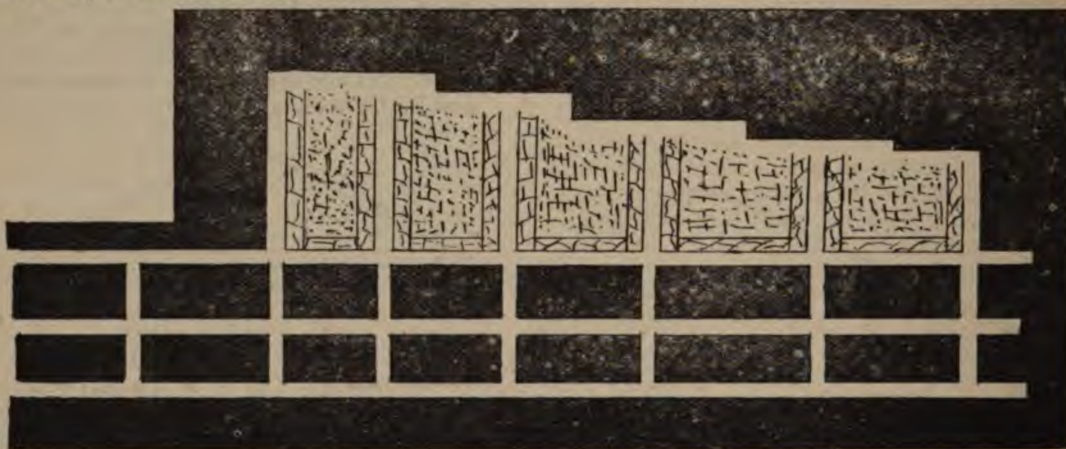


Fig. 1.

There are two methods of longwall, termed the advancing and retreating methods, or working away from the shaft and working back to the shaft.

Longwall Advancing.—The removal of the seam begins at the shaft pillar, the coal face being the whole length around the shaft pillar, taking the outward-bound face, as may be seen by fig. 1. The coal face is not always worked on a straight line, as circumstances very often regulate the line of face. The circumstances regulating the line of face are

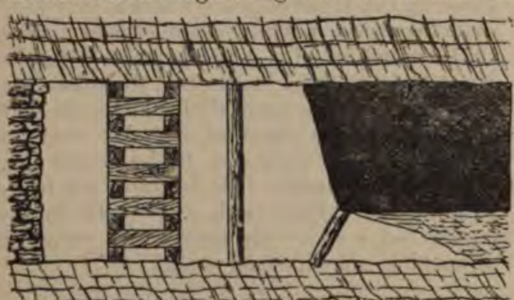


Fig. 2.

the nature of roof and floor, and the hardness of the coal. When the coal is soft it yields *better* coal by being worked on end, or on the cross-cut. Sometimes the coals are under-cut by machine coal cutters, but more generally by getters, the holing being done mostly at the bottom part of the seam, as the holing coal or band is mostly found there. By fig. 2 may be seen the method of holing, spragging, propping and chocking, the depth of the holing varying from three to six feet. The distance from sprag to sprag must not exceed six feet, thus protecting the getter from injury in the operation of holing. When the holing is finished the sprags are removed, and the coals wedged or blown down by means of shots.

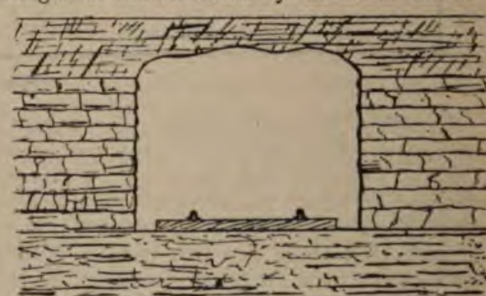


Fig. 3.

As the coal face advances the gates are advanced, new packs being built, and more rails laid. The packs are made of stone which is taken down in the gate to form height, or from the floor (fig. 3). Stone is also got out from the waste where the roof has broken down. In some cases the whole of the waste or goaf is tightly stowed, so much so that no timbering is done on the coal face, only the spragging. The distance apart of the gateways varies from ten to fifty yards, according to the thickness of the seam. When the gateways have advanced a long distance and the expense

of trimming increases, a main gateway or cross-gate is made, and new benk gateways are set off in the same direction as before, the old gateways being dispensed with. The main gate is usually called a cross-gate. The timbering done on the coal face varies according to the nature of the roof, the props being set alternately and at right angles to the dip of the seam. The cap or lid, in all cases, are put at right angles to the break in the roof, and across the break, as well as near the centre of large stones.

LONGWALL RETREATING consists of driving haulage roads from the shaft to the boundaries. From the haulage roads are driven levels and airways. When the boundaries are reached headings are driven so that the retreating face may be extracted in one long face. The holing done on the coal face is similar to that done in the other system, and the roof is set and drawn similar, the roof being allowed to fall. No gateways are left through the goafs, and as the coal face recedes the whole waste is left behind.

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### FIRST-CLASS.

*Question* 7.—How would you arrange the pit bottom of a mine, the output of which is expected to be large?

*Answer.*—In large collieries the pit bottom is so arranged that all the coal can be run on the cage at one landing. As the full tubs are run on the cage, the empty tubs are passed through slits at either side of the cage. The loaded tubs are arranged to come as nearly equal as possible from the various districts to supply the cages. When it is impossible to do this, hoists or inclines are made to regulate the supply. A continuous supply is thus maintained during the working day. By this means large quantities of coal are turned out of one shaft. The coals from other seams are got to this one landing by means of drifts or staple pits. By this means, stopping the cage at different landings in the shaft is avoided.

---

*Question* 8.—What rules would you enforce in a mine, with reference to timbering?

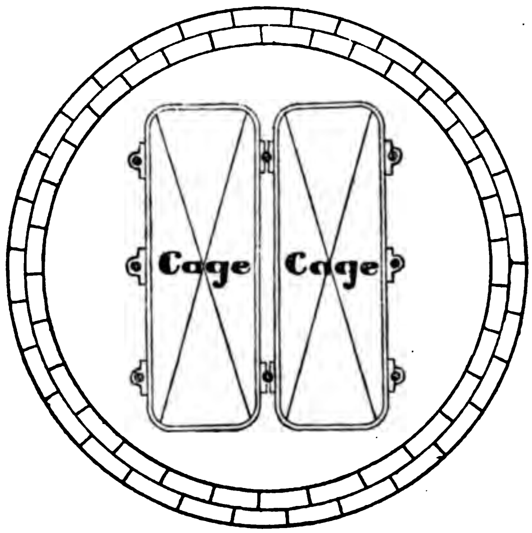
*Answer.*—Artificial support of some kind is invariably employed in different parts of a mine, and at many parts it is rendered compulsory by general rules 21 and 22 of the C.M.R.A., which states:—

"GENERAL RULE 21.—The roof and sides of every travelling road and working place shall be made secure, and a person shall not, unless appointed for the purpose of exploring or repairing, travel or work in any such travelling road or working places which are not so made secure.

GENERAL RULE 22.—Where the timbering of the working place is done by the workmen employed therein, suitable timber shall be provided at the working place, gate end, pass-bye, siding, or other similar place in the mine convenient for the workmen, and the distance between the sprags or holing props, where they are required, shall not exceed six feet, or such less distance as may be ordered by the owner, agent, or manager."

One of the most important points which tend towards the successful working and management of mines is to strictly comply with and enforce the above rules, and when such arrangements are rigidly and systematically carried out the safety of the workmen is as great as it is possible in that particular direction. The fixing of timber is most important, and may add to the safety and security of the workmen and the mine, or increase the dangers, according to the more or less practical way in which the timber is set. The sight of timber has a tendency to induce feelings of safety, and in order that such should be the case the following rules should be carefully observed by all persons whose duty it is to fix such timber:—(1) Before commencing to set timber the timberer should ascertain carefully to what part of the roadway or working place the timber requires to be set, viz.:—roof, side, or floor, or whether to two or more of these points at the same time. (2) He should study economy, consistent with safety. (3) Select sufficiently strong and suitable timber. (4) Always get correct measurements, by means of either a *reliable* tape or laths. (5) Study their positions as regards safety and strength. (6) The thick end of the props should be put next the roof. (7) The timber should not be weakened too much by the axe or saw. (8) If the timber be made for a bar or baulk and, as is often the case, has a round side, then the round side should, where practicable, be put next to the roof, thereby increasing the strength of the bar. If such timber be for a prop, the round side should be put to the side of the roadway. (9) Great care should be observed to erect as neat and strong a structure as possible.

*Question* 9.—You are required to put two cages, three tubs in a deck, in a shaft which originally was intended for cages with two tubs in a deck, and is, in consequence, very small for the size of the cages. How would you arrange the guide rods (wire rope) to prevent the cages colliding?

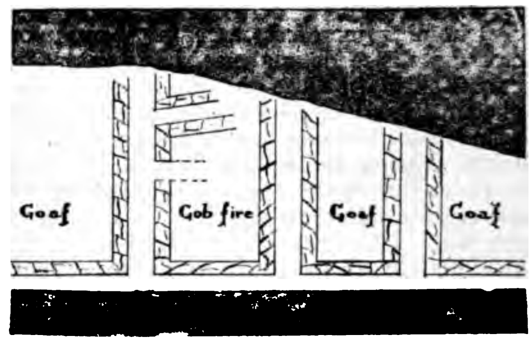



*Answer.*—In this case there would not be much room in the shaft, so I would arrange the conductors as shown in sketch. The outside guide ropes run through thimbles attached to the cages, whilst those on the inside hang free between the cages, rubbing strips being provided and fixed on the cages. The conductors between the cages are simply to keep the cages apart and avoid collision at meetings, and they answer that purpose admirably. The other conductors provide for side sway in every direction. The guide strips and thimbles should be fitted up with greasers.

---

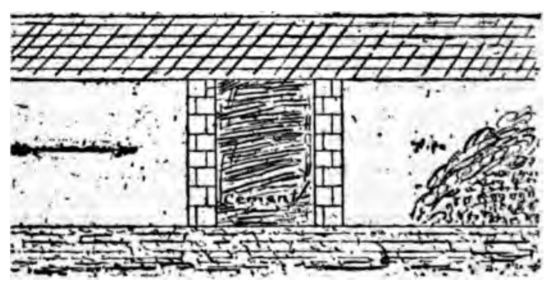
*Question* 10.—What is spontaneous combustion or gob-fires in a mine? How are they produced? Give a sketch of a gob-fire in the workings, and state how you would deal with it.

*Answer.*—These fires arise from various causes, but most commonly from the spontaneous combustion of coal taking place in the gob. There are several different opinions regarding their origin. Some authorities state that they are caused by the decomposition of iron pyrites mixed with a large quantity of finely divided coal. It is not necessary to have iron pyrites mixed with the coal in order to




have a gob fire. Small coal or slack stowed in the gob, and especially where the seam is at a great depth from the surface, may condense the gases given off from the coal, and the heat so developed is sufficient to give rise to spontaneous combustion.

Gob fires may arise from blown-out shots sending pieces of fuse, &c., into the gob, and if it is not extinguished it might easily set fire to the small coal stowed in the gob. A burning candle left against a prop, or let fall amongst broken timber or into a wood pack, may easily set fire to the timber and then catch the small coal in the gob. Both the above causes may be prevented by the workman extinguishing the burning fuse or candle before they have had time to ignite any of the surrounding material.



Prevention is better than cure, and to prevent gob fires is to keep all slack and timber out of the gob, and to have a strong current of pure air travelling through the workings to keep down the temperature as much as possible. In extinguishing gob fires one thing seems evident: if combustion has to be stopped we must take its supporter away, namely, oxygen of the air. I should first get as near the fire as I could, and, if water was available, try to drown it or extinguish it by that means. Failing this, I would seal it off, selecting the most suitable places for the stoppings and having as few as possible, choosing a place as sound and solid as possible with small sectional

area. In arranging for the stoppings I would have them all prepared and put in as nearly as possible at one time, except at the point at which the in-take air enters—that is, I would stop off where the air came out first, and so continue until I came to the in-take, as the products of combustion will help to extinguish the fire. Any explosive mixture being present would be rendered non-explosive, and the sealing up of the stopping in the in-take would be performed in fresh air. I would have the stoppings built of brick and cement packed in between, as shewn in sketch. If it was found that air got to the fire after the stoppings had been put in, I would conduct some carbon-dioxide gas through a tube fixed in one of the stoppings. This gas being very heavy would settle on the fire, and no doubt extinguish it.

## COMPETITION QUESTIONS.

TO the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d.**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best set of answers to each stage will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by August 11th, 1894.
5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—Describe briefly how coal or mineral is brought from the face to the shaft bottom.

*Question* 2.—What is coal, and how is it found? Give sketch.

*Question* 3.—What is fire-damp, and how is it dangerous in mines?

### ADVANCED.

*Question* 4.—What is the construction of safety fuse, and how is it worked?

*Question* 5.—Describe, with sketch, what you consider to be one of the very best fans in use at the present time.

*Question* 6.—Describe, with suitable sketch, the STRUVI ventilator, and discuss its efficiency.

### FIRST-CLASS.

*Question* 7.—Do equal quantities of air go to the dip and rise workings under similar circumstances?

*Question* 8.—How would you take an accumulation of gas out of a "hole in the roof," the "face of brushing," a "longwall cundie," and edge of the waste at a lift or stooping?

*Question* 9.—Describe with suitable sketches how sinkers are prevented from material falling down the shaft.

*Question* 10.—Two exhaust fans are placed in connection with an up-cast shaft; each fan is 20 feet diameter and 6 feet wide; one standing, and the other going at 60 revolutions per minute produces 80,000 cubic feet of air, with 1 inch of w.g. Find the quantity and w.g. of the following:—(*a*) one going at 80 revolutions per minute and the other standing. (*b*) Both connected to the up-cast, and going at 60 revolutions per minute. (*c*) One exhausting through the other.

## ANSWERS TO CORRESPONDENTS.

RECEIVED.—G. A. H., Advanced Miner, "Mining and Engineering World," "Technical Education," "Invention," "Colliery Engineer," Furnesian, and J. Pilgrim.

CERTIFICATED.—We take this opportunity of congratulating "Certificated," and all our other readers, who were successful at the last Science and Art Dep. Exam. To the unsuccessful we express our sympathy, and hope that their efforts to gain a certificate in the ensuing year will be re-doubled.

D. S. (Kimberley)—Many thanks for the Exam. results.

M. T. (Alfreton)—We are aware that the article, entitled—Colliery Valuation, which appeared in our last issue, was reprinted in an important newspaper, but we offer no objection so long as the source from which it was taken was given, in fact, we are rather pleased that it was thought to be sufficiently interesting to insert in a newspaper.

## AWARDS

FOR ANSWERS TO QUESTIONS IN THIS ISSUE.

ELEMENTARY.—Jas. Burrows, Chapel Street, Dalton-in-Furness.
*Commended.*—H. Hall, W. Talbot, J. Stevenson.

ADVANCED.—Edward Isaac, Shaw Cross, nr. Dewsbury.
*Commended.*—Hy. Talbot, T. Thorpe, J. Cook, J. Smith, G. Daykin.

FIRST-CLASS.—Geo. Robinson, Dallas Villas, Langwith, Notts.
*Commended.*—T. Banks, T. Simm, G. Makinson.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.
Envelopes to be marked "Correspondence."
Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.
Correspondence must not be enclosed with Competition Answers.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### Mathematics.

Sir.—In answer to "Mining Promoter" in your issue of July 14th, 1894, No. 17, Vol. II, I beg leave to submit the following, though of course it is a most unusual thing to hear of water weighing only 30 lbs. to the cubic foot:—

$16 \times 16 \times \cdot 7854 = 201 \cdot 0624$ feet area of shaft
$\therefore 201 \cdot 0624 \times 1500 = 301593 \cdot 6$ cub. ft. of water in shaft
1 cubic foot of water $= 6\frac{1}{4}$ gallons
$\therefore 301593 \cdot 6 \times 6 \cdot 25 = 1884960 \cdot 0$ gallons in shaft.

Then, if one cubic foot of water weighs 30 lbs., $\frac{30}{144} = \cdot 20833$. $\therefore 0 \cdot 20833 \times 1500 = 312 \cdot 495$ lbs. pressure per square inch is exerted by a column of water 1500 feet high, each cubic foot of water weighing 30 lbs.

David Lawn.

Above answer also sent by G. Collins.

### Dynamite.

Sir,—With your permission I will try to give "Young Student" an answer to his query as to the meaning of the sentence "Dynamite has a tendency to strike downwards."

In the first place we will describe the action of dynamite, and in fact every other explosive, in blasting. The explosive, when fired, is converted into gases which occupy a very small space in the shot-hole. These gases in the open air at atmospheric pressure would fill an enormous volume. By Boyle's law we are told that "the pressure of a given weight of gas varies inversly to its volume"; consequently, the gases being confined in so small a space in the shot-hole they exert a great pressure equally in all directions, which, provided the charge is strong enough, breaks away the rock at the weakest place, or in the line of least resistance. This illustrates the law of fluid pressure which says that "fluids transmit pressure equally in all directions." It will thus be seen that dynamite has *not* a tendency to strike downwards, or in any one direction more than another.

The above however has become a very popular fallacy, and has probably been derived from the fact that the rapid and violent action of dynamite is sometimes taken advantage of to break large stones, heavy iron, or steel castings, &c., the charge usually being placed on the top, covered with a piece of clay, and fired. It will also break into the solid rock or ground by simply placing a charge on top, and firing. In the case of stones, castings, &c., if supported above the ground and the charge placed *underneath*, the same results would follow as by placing it on top, it usually being placed in this position for the sake of convenience. I hope Mr. Cook will not take umbrage at me for thus going in direct opposition to this part of his answer, but many persons who ought to know better have got hold of this illusion which only requires a very elementary knowledge of the laws of fluid pressure to dispel. Apologising for taking up so much of your valuable space.

Mining Student.

### Mining Problems.

Sir,—In answer to the questions given by "Over Hulton" I forward the following solutions:—

1. There are two mines dipping 1 in 5, and they are 76 yards apart, a tunnel rising 1 in 5. What is length of tunnel?

As the tunnel is commenced from the lower mine which dips 1 in 5, it is evident if the tunnel rises 1 in 5 from the lower mine the gradient must be perfectly horizontal or level. Therefore, for every 5 yards the tunnel advances it comes one yard nearer the upper mine. As both mines are separated 76 yards the length of tunnel must be $76 \times 5 = 380$ yards.

But, another view of the question. Supposing it is meant the tunnel rises 1 in 5 from a horizontal plane, then for every 5 yards of tunnel driven the tunnel rises 1 yard vertical, whilst the tunnel (upper) has been approached another yard by reason of its dip. Therefore, for every five yards driven the tunnel and upper seam gains 2 yards nearer. Then, length of tunnel $= \frac{76 \times 5}{2} = 190$ yards.

2. What is the weight of coal in $1\frac{1}{2}$ statute acres; 4 feet thick, 18 cwt. to a cubic yard?

No. of sq. yards in 1 statute acre = 4840 square yards
" " $1\frac{1}{2}$ " $= 4840 \times 1 \cdot 5 =$ 7260 square yards. Cubical contents of 7260 square yards 4 feet thick $= 7260 \times 9 \times 4 = 261360$ cu. feet. Weight of coal in cwts. = as $27 : 18 :: 261360 = 174240$ cwts., or $\frac{174240}{20} = 87212$ tons.

3. A loaded tub weighing 10 cwt., standing on a level, takes a pull of 25lbs. to start it, what pull will be required to start it up an incline of 1 in 20.

Force required to overcome weight when on incline due to gravity $= \frac{10 \times 112}{20} = 56$ pounds.

As 25 pounds are required to overcome friction and other resistances, then total force required $= 56 + 25 = 81$ pounds.

4. The area of a square field being 3 acres 0 roods 20 poles, 16 yards statute measure. What is the length of one side in yards.

To find length of one side extract the square root of the area of the field. Thus, $\sqrt{15141} = 123 \cdot 9487$. Length of sides in yards $= 123 \cdot 0487$ lineal yards.

Trusting the above calculations will fulfil the requirements of "Over Hulton."

David Spence.

The above answers were also sent by "Mining Student," "Furnesian," Jesse Pilgrim, Bulwell.

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Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

Printed and Published by Strowger and Son Clarence Yard Wallgate, Wigan.


No. 19. Vol. II. SATURDAY, AUGUST 11, 1894. FORTNIGHTLY. ONE PENNY.

## CONTENTS.



# EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in No. 2, Volume II.*

## THE MAGNETIC NEEDLE.

ALL underground surveys are made either directly or indirectly with the magnetic needle. Practically speaking, this needle possesses the remarkable property of pointing always in the same direction, and it is by suitably taking advantage of this phenomenon that underground surveys are made with facility and accuracy, and the position of a ship in mid-ocean ascertained.

A belief amongst ignorant miners is that the surveyor can tell exactly the position of that portion of the mine in which he is situated, with reference to the surface, by simply looking at the dial. This is of course erroneous. What is required, to ascertain this fact, is the "diallings" from a fixed point which is marked on the plan. The diallings are the lengths and containing angles of a series of straight lines from the fixed point, which, in the first instance, is the pit shaft to that portion of the workings whose position is required.

The magnetic needle consists of a magnetised piece of steel at the centre of which is an agate cap which works on a pivot, and thus allows the needle to swing in a horizontal plane round a fixed centre. When allowed freedom to assume its own position the needle will oscillate from side to side for a short time like the pendulum of a clock, but of course in a horizontal plane, and will then settle in a position, the direction of which is almost north and south, one end which is marked to distinguish it, always pointing in a northward direction.

As has been previously remarked the needle does not settle in exactly north and south direction, and the difference between the magnetic north and the geographical north is known as the "declination" of the magnetic needle. This declination of the needle is not constant, but varies from year to year, and it also varies in different localities. The variation in any particular locality for a short space of time is very slight, but if it be neglected for a space of several years, serious errors will result.

The following table shows the declination from true north of the magnetic needle for the years named as determined at Kew Observatory:—

DECLINATION OF THE MAGNETIC NEEDLE FROM TRUE NORTH.

| DATE | DECLINATION | | | | |
|---|---|---|---|---|---|
| 1580 | 11 | degrees | 15 | minutes | east |
| 1657 | 0 | ,, | 00 | ,, | ,, |
| 1818 | 24 | ,, | 38 | ,, | west |
| 1880 | 18 | ,, | 57 | ,, | ,, |
| 1881 | 18 | ,, | 50 | ,, | ,, |
| 1882 | 18 | ,, | 45 | ,, | ,, |
| 1883 | 18 | ,, | 40 | ,, | ,, |
| 1884 | 18 | ,, | 32 | ,, | ,, |
| 1885 | 18 | ,, | 25 | ,, | ,, |
| 1886 | 18 | ,, | 17 | ,, | ,, |
| 1887 | 18 | ,, | 10 | ,, | ,, |

From the above table it will be seen that the magnetic meridian was in 1580 11 degrees 15 minutes east of the meridian, that it gradually receded towards true north until 1657, and proceeded on towards the west to 1818, when it arrived at its maximum western declination, from which time it has receded back again towards true north to the present time. The mean rate of declination from 1580 to 1887 is about eight minutes per year, while that of the last seven years, namely: 1880 to 1887 is about seven minutes per year, so that when making calculations the student should adopt one of these means, according to the period of the declination required.

There is also a constant variation in the declination at different places. Thus, at Liverpool it is about two degrees greater than at London, and at Edinburgh three degrees.

### To Plot the Magnetic Meridian on a Plan.

When an underground survey is to be made or even surface diallings to be plotted on a plan, the bearing of the line between two points which are shown on the surface plan should be found with the dial and the magnetic meridian plotted from this bearing. The bearing is usually taken between the centre of the shaft and the corner of some important building, or a suitable stonework station with a vertical staff, may be placed on one of the main lines of the surface survey in lieu of the building.

If a station as described above is employed, it may be possible to fix the dial immediately over the station and take a sight to the other object and thus obtain the bearing, but it is not always convenient by reason of local attraction on the needle, etc., to fix the dial exactly at one of the stations, in which case a point should be chosen midway, and after being approximately set in line, the dial is set and sights are taken to each of the stations. A sight should be taken to one station and the dial clamped in position on the legs, then it must be seen if the other station is in the same line by looking through the other end of the dial. If both sights are not exactly in the same line the dial must be moved a little to the side required and another trial made. When the sights are correct the bearing is noted, which let us assume to be 16 degrees north east. Now, on referring to the plan, a line is drawn between the two stations and the protractor fitted on, then a line drawn 16 degrees to the west of it will be the magnetic meridian. The reason why in order to obtain the meridian, the line is drawn to the west instead of what might appear at first thought to be the east will be easily understood by reference to Fig. 64.

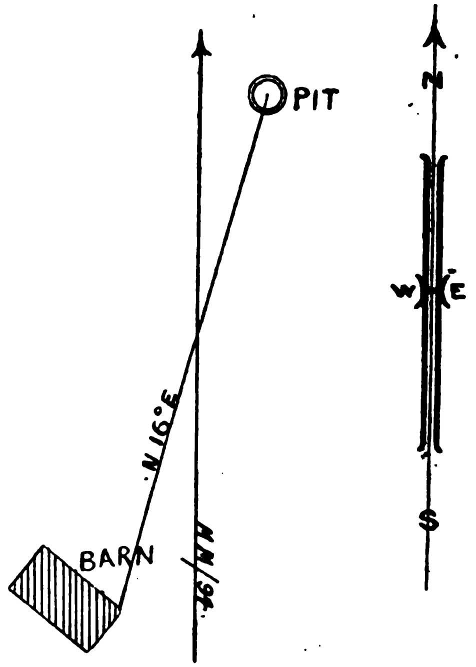



Fig. 64

### The Dating of Magnetic Meridians and Old Plans.

A meridian should be taken for every important survey and the date put on the plan so that no mistake will be made when the plan is referred to again at some future period. In the case of an old plan of underground workings on which the relative position of the surface is not shown with the exception of one pit shaft and the meridian of which is not dated, the true position of the workings cannot be ascertained without making a fresh underground survey which may be impossible; if, however the plan delineates two surface objects sufficiently far apart to admit of accurate work, a new meridian can be taken and an approximate idea of the date of the plan may be found by calculating the variation in the meridians.

### To Find the True North.

The variation of the magnetic needle for different localities renders it necessary to find the declination for ourselves when plotting diallings on plans, such as the Ordnance

maps on which the true north only is shown. There are several methods of finding the true north, the most common of which is the shadow method.

The sun at equal distances across the meridian is at equal altitudes above the horizon, and therefore gives shadows of equal length. If a staff is fixed in a vertical position in the ground, and the ends of its shadows joined when they are of equal length and this line be bisected, a line joining the bottom of the staff with the point of bisection is the true meridian. A more convenient method is to fasten a sheet of paper on a drawing board, and place a large needle in a vertical position, and find the meridian by the shadows of the needle in the manner described.

*(To be continued).*

# MURTON COLLIERY, DURHAM,

BY G. A. HAWES.

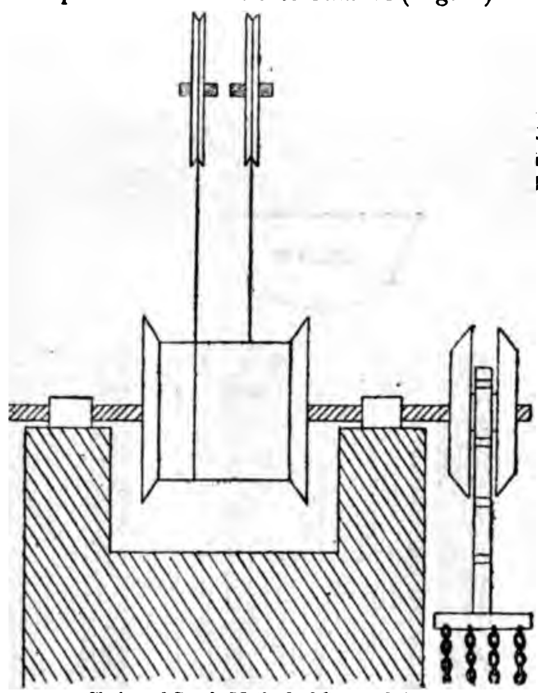
(With Illustrations.)

*Specially prepared for "MINING."*

(Continued from last Issue.)

WINDING AND DECKING ARRANGEMENTS.

TWO shafts are used for the winding of coals, viz.: — the east shaft and the middle shaft, the west shaft being used exclusively for ventilation. The east and middle shafts are both divided down the centre by a most efficient plank brattice, enabling coals to be wound from two different levels and by two separate winding engines in one shaft. The coals from the low main and main coal are wound from the middle shaft, whilst the east shaft is used for winding the Hutton seam coals and changing the men. Four winding engines are used—three for winding coal and one for the changing of men. The three used for winding coal are the old-fashioned vertical engines, which nevertheless give extremely good results; the engines are worked condensing, and are provided with 18 inch drums of the vertical type for flat ropes. The average winding speed is about a mile in five minutes, the writer having repeatedly timed the winding from the Hutton seam (240 fathoms), and found it to be one minute, and this, when the vacuum in the condenser was only moderate owing to the condensing water being heated. The ropes used are flat, measuring about 4 inches across and 1 inch in thickness, and made of the very best material; they are renewed once a year under all conditions, and some extremely good ropes are taken off, for which a ready sale is obtained for the manufacture of steel nails. The engines (vertical) are all provided with the chain and staple method of counterbalance (Fig. 2.) A

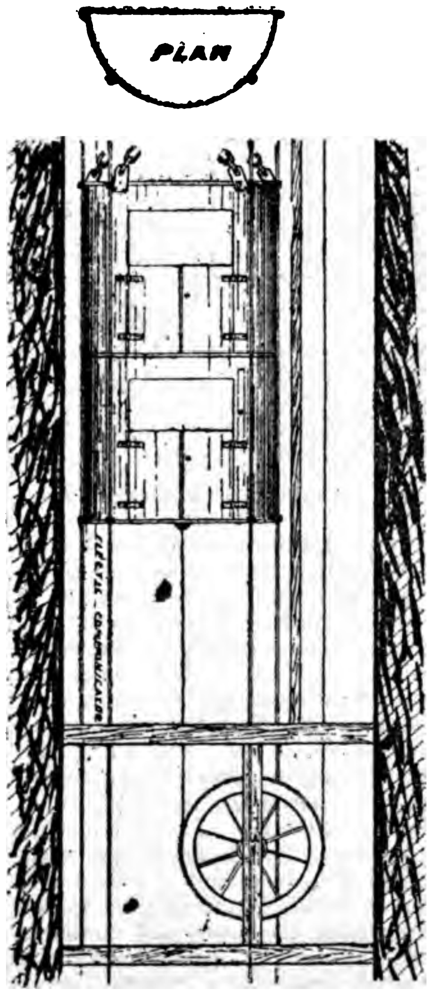


Chain and Staple Method of Counterbalancing.

Fig. 2

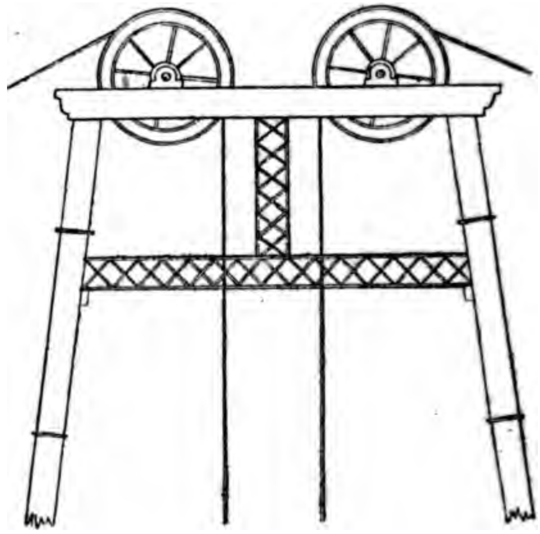
small vertical drum is secured to the end of the drum shaft, and upon this drum is wound a rope or chain with a heavy weight at the end, which works up and down a small staple; the rope is coiled, so that when the engine has made half a wind it is all uncoiled and the action reversed. When the loaded cage is to be lifted from the bottom, the chain is all coiled round the small drum and the weight hanging suspended in the staple, thus exerting its power on the drum shaft and tending to lift the loaded cage, the engine is started, down proceeds the weight until half a winding is made when the weight is on the bottom of the staple and all the rope on the drum uncoiled, the drum still continuing to revolve, lifting the heavy weight which is exerted against the rapidly descending empty cage and maximum length of rope. This method is a cheap and reliable method, besides being simple in every detail.

The cages in the coal winding shafts are four-deckers and weigh 37 cwt., carrying one tub in each deck; they are attached to the rope by four bridle chains. The conductors for these cages consist of wood spears of pitch-pine, running in shoes or grooves attached to the cage. A large bunton is carried vertically down the shaft, and fastened to horizontal horse-trees built into the brick-work; upon this bunton which is of red pine and about 12 inches in section are fastened the spears by countersunk spikes. The remaining winding engine used for changing the men is a beautiful and powerful horizontal engine. This shaft and the arrangements are most elaborate, being second to none in the coal trade. One cage (Fig. 3) of a semi-




Plan and Elevation of Cage for Winding Men.
Fig. 3

circular shape is used, having two decks which have at their entrance iron hinged folding doors; each deck is capable of holding fifteen men with convenience. The cage is conducted by four flexible wire rope conductors running through thimbles attached to the cage; to the bottom of this cage is attached a tail-rope which works round a vertical pulley, working in a sliding frame and situated in the lowest extremity of the shaft; the tail-rope is passed over a pulley at bank and on to the drum where it effects a perfect counterbalance. The signalling in this shaft is also extremely elaborate; a chargeman accompanies the cage, in which there is an electric bell which is rung from the various stations in the shaft to the chargeman alone, who is also provided with an electric spring push which conveys a current to the bell situated in the engine-house. The cage can be directed to any station in the shaft, or stopped at any point by simply pressing the spring push. This cage is provided with the Ormerod detaching hook, the engine being also supplied with a steam brake to prevent overwinding. This handsome engine-house is illuminated by one extremely powerful electric lamp.



Elevation of Headgear.
Fig. 4

The vertical engines are provided with the common cylindrical egg-ended boilers for the generation of steam, whilst the steam for the horizontal engine is generated by three large tubular boilers; on the whole the winding arrangements are excellent, but the writer found a serious fault in the vertical engines being provided with no possible means whatever of preventing an overwind, they being possessed of nothing but the common strap brake, worked upon half the circumference

of the drum, the power being applied with the ordinary foot lever; this form of brake is practically speaking useless in the case of an overwind. A case of the crank pin breaking three years back, brought the loaded cage with dreadful velocity to the pulleys where the rope was drawn from the capping, and the cage deposited upon the heapstead severely smashing the decking arrangements; the engineman applied his brake to the drum, but his efforts to stop it were futile; the necessity of a brake similar to Burn's brake which will render the drum stationary in any part of the shaft is extremely felt.

The head-gear (Fig. 4) is made of the best lattice iron work, having for its foundation and support large hollow iron columns; the head-gear is so constructed as to do for two winding engines, two sets of pulleys being supported by one range of head-gear.

(*To be continued.*)

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager.**

WEST LANCASHIRE & NORTH WALES DIVISION (JUNE, 1893). COMMENCED IN No. 18.

### FIRST CLASS.

### Principles of Mechanics & Machinery.

QUESTION 6.—Given a feeder of water of 30 gallons per minute to be conveyed in close pipes along an undulating road, 500 yards long, the head of water at the starting point being two feet. What size of pipes would be required?

ANSWER.—*Molesworth* gives the following rule:—D = diameter of pipe in inches; H = head of water in feet; L = length of pipe in feet; W = cubic feet of water discharged per minute.

To find size of pipe required:—

$$D = \cdot 538 \sqrt[5]{\frac{W^2 L}{H}}$$

A cubic foot of water = 6·25 gallons, therefore 30 ÷ 6·25 = 4·84 cubic feet of water discharged per minute,

Then we have $H = 2$ feet

$L = (500 \times 3) = 1500$ feet

$W = 4{\cdot}84$

$$\text{Therefore } D = \cdot 538 \sqrt[5]{\frac{4{\cdot}84^2 \times 1500}{2}} =$$

3·75 inches diameter of pipe required.

QUESTION 7.—What amount of expansion do you expect in a vertical range of steam pipes 150 yards long? How would you provide for such expansion?

ANSWER.—I should expect from about five inches to six inches of expansion, and to allow for this I should put in the range of pipes two expansion joints which would be adequate for such expansion, even if it were a little greater than six inches.

QUESTION 8.—Explain the difference between an ordinary safety valve and "Cowburn" or "Hopkinson's" valve. Compare their respective merits.

ANSWER.—An ordinary safety valve is of the lever kind, and it differs from the "Cowburn" or "Hopkinson's" dead-weight safety valve, inasmuch as the former is so arranged that the weight which regulates the pressure, the boiler is to work at is placed on the arm of the lever. The distance from fulcrum which such weight has to be placed is calculated according to given rules. Also the weight to be put on lever is calculated accordingly. This valve is more liable to be overloaded than the latter, because a very slight weight added makes a great difference owing to the multiplying effect of the lever. The spindle of this valve is liable to become inoperative by wedging and corrosion, or by neglect. Also the fulcrum joints are liable to become furred up to such an extent as to make the lever immovable.

"Cowburn" or "Hopkinson's" patent dead-weight safety valve is an excellent fitting for any boiler, and very simple. Centre of gravity is very low, and not so liable to stick as the other kind. Besides this a great extra weight is necessary to overload the valve. Therefore valve of this kind, of a good construction, has many advantages over the lever kind, and is coming rapidly into use. The great feature in the dead-weight valve is its great protection against serious overloading, and with those of a good type the construction is such that, in the event of extra weight being applied they cannot fail to attract attention, because for every additional one pound per square inch of pressure desired, this weight must be increased by the same number of pounds as there are square inches in the area of the valve.

The rules for ascertaining the proportion of valves and weight are:—

Let A equal area of valve

" P " pressure in lbs. per sq. inch

" W " weight to be placed on valve

When A and P are known, W is found thus:
$$A \times P = W$$
When A and W are known, P is found thus:
$$W \div A = P$$
When W and P are known, A is found thus:
$$W \div P = A$$
If $A = 8{\cdot}5$ sq. inches, and $P = 70$ pounds, then $W = 8{\cdot}5 \times 70 = 595$ pounds

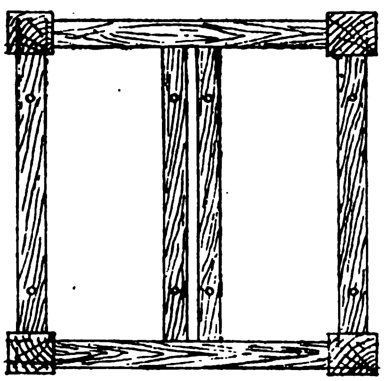
If $A = 8{\cdot}5$ sq. inches, and $W = 595$ pounds, then $P = 595 \div 8{\cdot}5 = 70$ pounds

If $W = 595$ pounds, and $P = 70$ pounds, then $A = 595 \div 70 = 8{\cdot}5$ sq. inches.

So that, according to the above rules, in order to overload this valve, even to the extent of one pound per square inch, you would have to place 8·5 pounds more on the valve, which could not fail to be seen by those who have the inspection of the boilers under their charge.

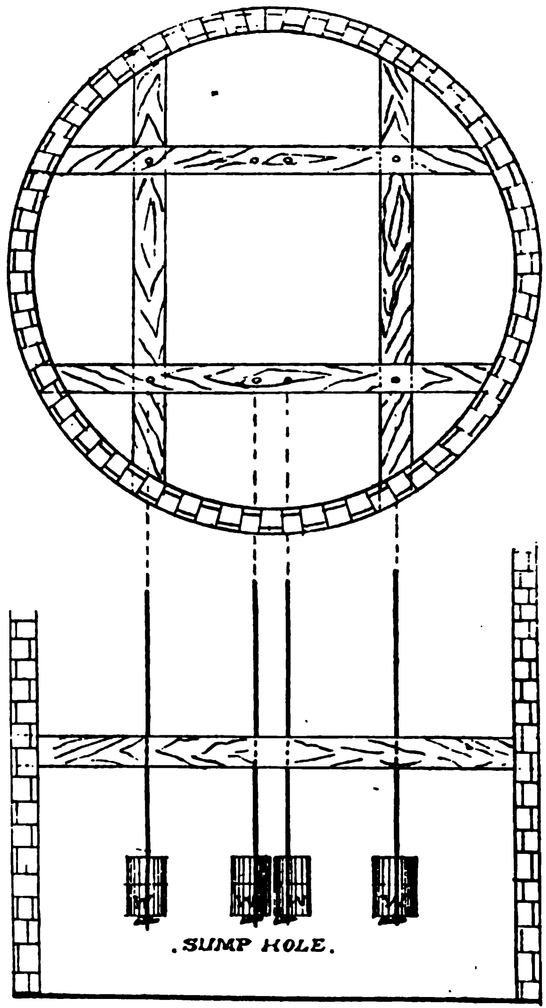
QUESTION 9.—What weight would you have on each of eight conducting rods in a shaft 500 yards deep, where the rods are each 1½ inches diameter? Describe and give sketches of the requisite arrangements at the top of the headgear and in the sump hole.

ANSWER.—I should have 3·5 tons on each rod. In a shaft where eight guide rods are used, they are arranged with four rods to each cage. (See sketches.) By this means it prevents a greater amount of oscillation of cages than otherwise would be the case by only using two, or even three, to each cage. In order to secure the rods on the top there are four large pieces of timber over the head stock of headgear, and through each of these, holes are bored to allow the ends of the rods to pass through (Fig. 1), and on the upper



**Sectional Plan of Headgear.**
**Fig. 1.**

side of these beams the rods are secured by several pairs of clams on each rod, by which means they are held firm, so that the weight required at bottom could be put on to hold the rods fairly tight. The rods below in the sump hole pass through beams to keep them in their position, and underneath these beams the weights are put on each rod, according to weight required.—(See Fig. 2.) The weights chiefly used are round and




**Plan and Elevation showing position of guide rods at bottom of shaft.**
**Fig. 2.**

2 cwt. each, and have a slot in one half of each weight so that they can be easily put on and taken off when required. At bottom of each rod it is usual to weld a piece of iron so that a hole can be punched through for a gib or cotter to be put in, and over this a strong iron washer for the weights to rest on.

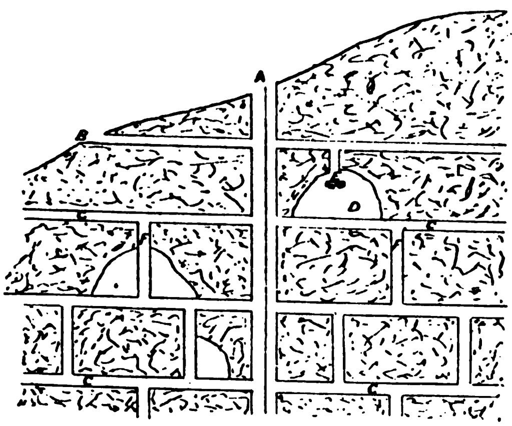
*(To be continued.)*

## ANSWERS TO QUESTIONS

### In No. 16, Vol. 2.

### ELEMENTARY.

*Question* 1.—What are shafts, stopes, and winzes? Show the application of those terms in a sketch of a mine on a lode.




**Longitudinal Section of a Metal Mine.**

A Shaft B Adit Level
C Levels D Stope
E Stull F Winze

*Answer.*—Shafts in vein-mining are almost always vertical until 30 to about 70 fathoms is reached, after which they usually follow the underlie of the lode. Occasionally shafts are inclined, but those that are vertical throughout are not uncommon, communication being effected by cross-cuts.

Stopes.—The bulk of the ore is got out by the process of stoping between the levels in those portions which are judged sufficiently rich, that is, in the "bunches" or "shoots" of ore. Overhand stoping, as shewn in sketch, is the most economical method. The ore is broken more cheaply than in underhand stoping, but more timber is required for the stulls (E) upon which the men stand, though sometimes the ore is left in the level for a time if it is not wanted immediately, and this serves the same purpose as a stull or platform. As the levels become extended, it is neceesary to open the communication between them. This is done by sinking small shafts, called winzes, between two levels for purposes of ventilation, and also to discover the nature of the lode between the levels. The partition in the shaft (A) divides the winding shaft from the pump shaft and ladders.—John Stephenson. Wharton Street, Coundon, Bishop Auckland.

*Question* 2.—Describe briefly how circulation of fresh air is kept up through the workings of a large mine.

*Answer.*—There are several ways of keeping a supply of fresh air in circulation in our mines.

Natural Ventilation.—In some shallow seams they manage to get a moderate supply of air by the natural conditions of the seam. This I will not explain, but go on with the ventilation of deep mines produced by artificial means.

Furnace Ventilation is most effective in deep dry shafts, for in shallow pits little motive column can be obtained, the water trickling down the sides of the shaft neutralising the action of the furnace. A properly-constructed furnace is generally estimated to produce about 6,000 cubic feet of air per minute for each foot in breadth. The useful effect is of course very materially affected by the depth of the shaft, the quantity of air produced varying according to the square root of the depth from the surface, so that the deeper the shaft and the greater the temperature of the furnace, the greater will be the quantity of air produced.

Steam Jets are also used to assist the ventilation, and, although not in itself sufficient to produce very large quantities of fresh air, it may greatly assist the already existing means, and in cases of emergency may keep a current of air in a steady circulation in the mine. At some collieries the exhaust steam of the engines is conducted into the up-cast shaft, and made to issue in small jets from small perforations in the pipe. In both these systems the current of air is created by rarefying the current of air in the up-cast shaft by the application of heat, which thus becomes lighter than the air in the down-cast shaft, and so produces a difference of pressure, which causes a current of air to be set in motion from the down-cast to the up-cast.

Mechanical Ventilators are also used, especially in deep mines and where the working places are a long way out in the mine. The current is produced by placing an exhaust fan at the top of one of the shafts (which is covered over at the top), and which, on being rapidly revolved, exhausts the air, thereby creating a partial vacuum, when the in-flowing air from the down-cast shaft rushes in to take its place, thus causing a current of air to circulate. There are, of course, numerous varieties of these fans, but those which are most generally used are the Guibal, the Waddle, the

Schiele, and the Capell, or some modification of these all being centrifugal fans. By centrifugal fans is meant that when the fan revolves the air is taken in at the centre, and from thence is driven in the direction of a curve and discharged at the orifice, thus creating a vacuum.

Splitting the air is also essential in mines. The advantages of splitting the air in mines and supplying each district with fresh air are:—(1) Less ventilating pressure is required to produce the same amount of air. (2) The men have purer and fresher air to breathe. (3) By splitting the main air currents in mines and giving to each disirict a separate supply of fresh air, we take advantage of the C.M.R.A. for blasting, where each district is treated as a separate mine.

Regulating is also adopted in mines to regulate and cause a circulation of fresh air in each district, or to throw extra pressure on any particular point, regulators are put in. They are simply wooden frames built into a brick wall for the purpose of contracting the area of the air-way so as to check the course of the air current, and force a larger quantity of pure air in another direction.—John Hy. Senior, 16, Thompson Row, High Street, Rawmarsh.

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*Question* 3.—Describe the principle of main-and-tail rope haulage underground.

*Answer*.—In the main-and-tail rope haulage system, a single line of rails is required on the main road, and at the landing or stations two lines of rails are required—one for the full tubs and one for the empty tubs. The tubs are coupled in sets ranging from 20 to 90 corves at a time, and two ropes are attached to the set. The main rope hauls at the out-bye end, and the tail-rope at the in-bye end. The main-rope hauls out the full corves, and the tail-rope hauls in the empty corves. Each rope is wound on a separate drum, and each drum may be put out of gear by means of clutches worked by levers. As the tail-rope is wound on to its drum the train of empty tubs is drawn in and the main-rope is run off the other drum, so that when the train reaches its destination the main-rope is ready for being attached to the full corves. The tail-rope, which should be twice the length of the incline, passes along the roadway and round a large wheel at the extreme end of the road, and then returns back alongside of the road. After the empty tubs have been taken off, and the full train got ready, the main rope is attached to the front of the train, and the tail-rope fastened behind. The tail-rope drum is then thrown out of gear and the main-rope drum into gear, the engine is reversed, and the full train drawn out. Rollers are placed between the rails on all the roads on which the tubs are hauled. These rollers should never be more than ten yards apart, because if they are placed at too great a distance from one another, the ropes are always rubbing the floor, thereby causing serious and unnecessary friction and damage. The tail-rope system of haulage is very suitable for seams where the main roads have a varying inclination, and the roof and thill are not of such a character as to allow wide roads to be cheaply maintained. It is also very useful for working a large number of branch ways. An independent tail-rope is placed on each branch way, and when the set arrives at the junction of the branch with the main road, or, as is sometimes done, before the sets start from the shaft, the branch tail-rope is attached to the main tail-rope at the junction. John Henry Senior, 16, Thompson Row, High Street, Rawmarsh.

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## ADVANCED.

*Question* 4.—Describe, with sketch, the South Wales method of single-stall workings.

*Answer*.—The single-road and double-stall roads are chiefly practised in the noted South Wales coalfield. This system is only a modification of the pillar-and-stall method. In the single-stall mode the main levels are advanced from both sides of the pit bottom

by working places opened out off the main roads, from 6 to 10 yards wide. These form the stalls or working places for the men—generally two men, and a strong lad to fill the coals and tram it into the pass-bye. At the very commencement of the stalls from the main headings they are not quite so wide as they are after advancing into the solid, when they are properly widened out. The object of leaving this rib of coal next to the heading road is to preserve it and give it more security for the transit of mineral, etc. The width of these stalls is determined by the amount of debris (dirt and stone) yielded which is expected to be provided for gobbing and packing, because, in the single-stall the packs are formed and built down the centre of the stall, and the corve road is left on one side which serves as an in-take, and an air-way not less than two feet wide on the other side to act as a return airway. After the stalls have advanced from 60 to 100 yards the pillar is cut through, and the right-side rib is worked back with the same road. In some cases the stalls meet each other driven in the opposite direction from the parallel main headings, which are driven forward about 180 to 200 yards apart. The system really should be called the advancing and retreating single-stall operation. This single-stall system, though abandoned in many parts of the country, is suitable where the seam is of a strong compact nature, with moderate roof and pavement. (See sketch.)—SAMUEL DAVIES, Park Road View, Worsbro' Bridge, near Barnsley.

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*Question* 5.—How is a coalfield containing a large number of seams with a high dip laid out for working.

*Answer*.—There are various methods of opening and working out collieries in different parts of the country, but the best system which is considered most favourable in one part of the coalfield is regarded as unsuitable in another. This arises from the diversified character the coal seam often presents. Also, there are other cardinal principles to be considered in starting any new pit, and before commencing I would desire the following information:—(1) The amount of inclination of the seams. (2) The thickness of the seams, whether any bands or dirt partings are in them or not, and the kind of roof and pavement. (3) The nature and physical character of the different seams. (4) The position and number of faults that traverse the coalfield. (5) The thickness and nature of the intervening strata between each seam. (6) The area of royalty apportioned to each mine. (7) The depth of each seam from the surface. (8) The surface plan and plant. Moreover, we can mention other minor circumstances, because it requires technical knowledge and discrimination on the part of the manager who is determining how and which is the best, safest, healthiest, and most economical mode to adopt in laying and dividing the mine, for working and the getting operations. From the first point we could fix the course of the main haulage roads, and take advantage of the gradient for the transit of mineral, the tramming into the different pass-byes, and the drainage of the mines. From the points 2, 3, 4, 5, 6, and 7, we would be able to decide and adopt the best mode of working such seams, the probable cost of getting, timbering, the system of ventilation, and the kind of underground machinery (if any) required. From the last point, but not least, because from the surface plan and plant shewing the whole surface buildings, railways, reservoirs, etc., etc., we could partly calculate the number of men that would be employed, and the quantity of output, per day, of coals could be expected to be raised from such colliery. There is nothing more conducive to the success of mining operations than a good plant. The surface plant speaks to the passer-by of what he may expect is the general state of the underground laid-out workings. The adoption of the best plant of the most efficient substantial character, is the most economical in the end. As to how mines should be laid out for working, it is impossible to lay down one rule that would suit all cases, although we may say that there are modes which may be adapted to the ever-changing circumstances, or the multifarious requirements of the mines in different parts of the same coalfield. Careful consideration of the above points will greatly aid the mining student to decide best the means to lay out his new pit for mining operations. — SAMUEL DAVIES, Park Road View, Worsbro' Bridge, near Barnsley.

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*Question* 6.—Give an account of the Lancashire and Cheshire coalfield.

*Answer*.—The coalfield generally known under the above name occupies and forms an important part of that usually named in the list of coalfields of Great Britain. In area it occupies the greater part of the southern portion of the County of Lancashire, and it

extends into parts of the adjoining Counties of Cheshire, Derbyshire and Yorkshire. Its breadth from north to south is about 6 miles; its length from west to east is about 36 miles; and the total area exposed is about 217 miles. Mr. BINNEY, the noted and most assiduous geological explorer of this coalfield, estimates its thickness at or over 7,000 feet, formed into three distinct portions, viz.:—(1) The upper coalfield, including the peculiar Hardwick limestone which contains numerous fish remains and several thin beds of coal. (2) The middle coalfield, 3,500 feet. This series contains all the more important seams from the Worsley 4-feet downwards. (3) The lower or gannister series. The term "gannister" is applied to a peculiar close-grained bed which accompanies some of the mountain mine coals. This series ranges through Eccleston, Lathom, Knowsley, and Huyton on the south, dipping under the newer formations of the trias and permian period on the south-east. Then it crosses the Mersey on the north, and is bounded by the millstone grit or rough rock, which runs to a considerable elevation. The sedimentary strata thickens very much towards the north, as will be seen by the Pemberton 2-feet and 4-feet being 15 yards apart at Wigan, while at Bamfurlong, only a few miles further south, these seams run so closely together that a dirt parting is scarcely perceptible, and they are worked conjointly, under the name of the Bickershaw 7-feet mine. The coalfield is very irregular in form, and much intersected by great faults which dislocate the strata several hundreds of yards. These are chiefly the following, which run in a general N.N.-W. direction, fairly parallel to each other, and at a distance apart of about 1,400 yards:—The great Pemberton fault from Ashton-in-Makerfield to Shevington, a down-throw on the east, varying from 250 to 470 yards. The great Shevington fault is traceable from Edge Green to Heskin, having a down-throw to the east of about 600 yards. The Giant's Hall fault from Abram to Standish Church, a downthrow on the west of about 600 yards. The great Standish fault passing by Amberswood Colliery, under St. Catharine's Church, and past Boar's Head, a down-throw to the east of about 160 yards. The great Haigh fault running past Bickershaw Colliery, Kirkless Hall, Haigh and Ellerbeck, a down-throw to the west of about 600 yards. The Irwell Valley fault, near Manchester, has a down-throw of 1,000 yards, and brings in the new red sandstone.

The different seams vary in quality and thickness. The most valuable seam is the cannel coal, which still keeps up its reputation as a gas-producing material. It thins out in every direction from Wigan as a centre. The sections of the strata are as follows:—

| NAME OF MINE. | THICKNESS. Yds. | Ft. | Ins. |
|---|---|---|---|
| Thin Coal .. .. .. | 0 | 1 | 3 |
| Yard Mine .. .. .. | 1 | 0 | 2 |
| Pemberton 5-feet .. .. | 1 | 0 | 10 |
| „ 2-feet .. .. | 0 | 1 | 11 |
| „ 4-feet .. .. | 1 | 0 | 8 |
| Wigan 5-feet .. .. .. | 1 | 1 | 1 |
| „ 4-feet .. .. .. | 1 | 1 | 1 |
| „ 9-feet .. .. .. | 2 | 2 | 2 |
| Cannel .. .. .. .. | 0 | 0 | 7 |
| King Coal .. .. .. | 1 | 0 | 4 |
| Queen Coal .. .. .. | 0 | 1 | 5 |
| Ravine Mine .. .. .. | 2 | 1 | 9 |
| Yard Coal .. .. .. | 1 | 0 | 0 |
| Bone Coal .. .. .. | 0 | 2 | 3 |
| Orrell Coal 3-feet .. .. | 1 | 1 | 9 |
| Orrell 4-feet or Arley .. .. | 1 | 0 | 6 |

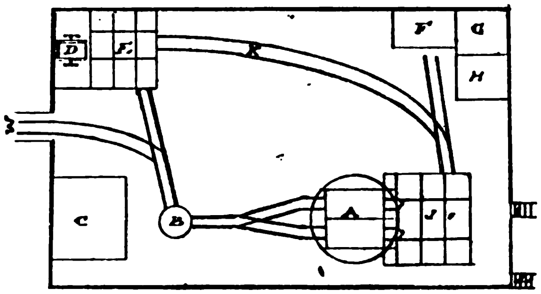
Above the strata represented in this section there are also the following mines occurring in this district:—

| | |
|---|---|
| Riding Mine .. .. | 3 feet 8 inches |
| Ince Yard Coal .. .. | 3 „ 0 „ |
| Ince 4-feet Coal .. .. | 3 „ 7 „ |
| Ince 7-feet Coal .. .. | 7 „ 0 „ |

In all there are about 80 or 85 feet thickness of coal—of which about 60 feet is of average quality—in about 2,600 feet of strata. The whole of the coal seams include all the graduations from a very free burning coal like the Pemberton 2-feet or 4-feet, to the very bituminous or coking coal like the Arley. The latter is the most important in the district, and is excellent for gas making. The Wigan 6-feet, or 9-feet as it is called, needs a special word on account of its "fiery" character, which has unfortunately been the scene of a series of very fatal explosions within the last 25 years. The coalfield furnishes coal suitable for all purposes for which it is required. The peculiarities of the coalfield are as follows:—(*a*) The carboniferous or mountain limestone does not appear at the surface at all within the whole area. (*b*) The field does not yield or produce ironstone and limestone for iron smelting, consequently, the supply of these materials to the blast furnaces at Kirkless, &c., has to come from a distance. (*c*) Brick clay is very plentiful over most of the field, affording material for an important industry. The Cheshire coalfield is formed of the lower and middle series continuous of Lancashire in their extension beyond the Mersey. The mines are worked both by the pillar and stall and the longwall method.—SAMUEL DAVIES, Park Road View, Worsbro' Bridge, near Barnsley.

## FIRST-CLASS.

*Question* 7.—Describe, with sketch (plan), what you consider to be a good arrangement of the tram roads of a heapstead. Show also the usual plant of the heapstead.




REFERENCES:—

A—Shaft Frame
B—Turn-table, to turn tubs
C—Weigh Cabin
D—Kick-up, for emptying tubs
E—Sheet-irons or Flat-sheets
FGH-Cabin for sharpening tools
I—Steps into engine-house
J—Flat-sheets
K—Tramway for empty tubs
L—Steps from ground to heap-stead
M—Road on to stone-heap

*Answer*.—By this arrangement three men can bank out a large quantity of coals. From the cage to the turn-table, from the turn-table to the tilter is dipping slightly, say three-sixteenths of an inch per yard. Now, after the tub is emptied it is pushed up an incline, towards K on the sketch, and this gives it a slight descent to the flat-sheets behind the shaft.

Now, one man lifts the catch, gets all full tubs out of the cage, puts them on the weigh, turns them round, and sends them away to the tilter. One man at the tilter empties all the tubs, and puts them, one by one, over the hill top, and lets them go on to the flat-sheets. The man behind the cage gets the tubs as they come from the tilter, sets them ready, and as the cages come up full he pushes in the empties, thereby pushing out the full ones.—JOHN HARRISON, Ashington Colliery, Northumberland

*Question* 8.—Construct a table of mine gases, including the simple gases, giving the names, chemical formula, composition, and weight, as compared with air and hydrogen, and properties of each as regards supporting life, combustion, and combustibility.

*Answer*—The compound gases generally met with in mining are composed or made up of elementary gases.

| Gases | Chemical Formula or Symbol | Composition | Weight |
|---|---|---|---|
| Hydrogen ... | H | Simply Hydrogen Gas | 1· |
| Oxygen ... ... | O | ,, Oxygen Gas | 16· |
| Nitrogen ... | N | ,, Nitrogen Gas | 14· |
| Carbon ... ... | C | Vapour of solid Carbon | 12· |
| Sulphur ... ... | S | ,, solid Sulphur | 32· |
| Air ... ... | | | 1·000 |
| Marsh Gas .. | $CH^4$ | 1 volume of Carbon; 4 ,, Hydrogen | ·557 |
| Carbonic Acid ... | $CO^2$ | 1 ,, Carbon; 2 ,, Oxygen | 1·532 |
| Sulphuretted Hydrogen ... | $H^2S$ | 1 ,, Sulphur; 2 ,, Hydrogen | 1·184 |
| Carbon Oxide ... | CO | 1 ,, Carbon; 1 ,, Oxygen | ·967 |

HYDROGEN will not support life, but destroys it by suffocation. It is not combustible, nor will it support combustion.

OXYGEN actively supports life and combustion, and is combustible.

NITROGEN neither supports life nor combustion, and is not combustible.

CARBON is generally found as a solid, and is the chief ingredient of coal and coke.

MARSH GAS will not support life, is combustible in air, and supports combustion.

CARBONIC ACID GAS will not support life nor fire, and is not combustible.

HYDROGEN SULPHIDE will not support life, and kills as poison. It is combustible, but it will not support combustion.

CARBON OXIDE is very deadly to human life, if breathed. It is itself combustible, but will not support combustion.—JOHN HARRISON, Ashington Colliery, Northumberland.

*Question* 9.—Describe how you would fix wire rope guides in a shaft, and give an approximate rule for the weight of conductors to use, and the weight to attach to the conductors to keep them tight. If the weights in the sump were covered with water, and you wanted to know if they were hanging properly, how would you proceed supposing it is not practicable to empty the water.

*Answer*.—To fix wire-rope guides in a shaft the first operation would be to un-coil the rope from the reel, and wrap it on the capstan drum. Then get the rope over a pulley fixed in the head-gear, cap the end of the rope, and attach the weights to it, and lower it down the shaft. Having reached the bottom the weights are taken off and the end of the rope passed through the bearer, and the weights hung on again. Two beams are then placed across the top of the shaft, one on either side of the

rope. The rope is then secured by several pairs of clams over these beams. The conductor is then cut off to the required length, and the end passed through the beam near to the top of the headgear, and secured at the top side by several other pairs of clams. The temporary clams are then taken off, and the conductor hangs in its proper position in the shaft.

The rule to find the weight to attach to the end of conductors to keep them tight is to allow 1 ton for every 100 yards in depth, therefore, for a shaft 600 yards deep it would require 6 tons fastened on each conductor, and for a rope to carry this weight (6 tons) we should require it to be $1 \times 1 \times \cdot 9 \times 300 = 270$ pounds, and the safety load of a one-inch rope will be $1 \times 1 \div 3 = \frac{1}{3}$ of a ton, or 746 pounds. Therefore, $746 - 270 = 476$ pounds. A one-inch rope will safely carry 476 pounds after deducting its own weight, and $6 \text{ tons} = 131440$ pounds total weight. This $\div$ by $476 = 25$, and $\sqrt{25} = 5$ inches rope required.

If the weights were only overhead in water and no dirt or sludge had accumulated in the sump round the weight, no danger need to be apprehended, so that I would find out whether the debris had accumulated in the sump to such an extent as to keep the weights in a fixed position, and not allow them to rise and fall as required.—THOS. BANKS, Church Road, Haydock.

## AWARDS

FOR ANSWERS TO ABOVE QUESTIONS.

ELEMENTARY.—J. H. Senior.
*Commended.*—J. Daykin, J. Hodgson. Hy. Hall, W. Talbot, J. Bailes, E. Colbeck, J. Stephens, J. T. Ward, W. H. Knight.
ADVANCED.—S. Davies.
*Commended.*—S. Thorpe, H. Talbot, G. Daykin.
FIRST-CLASS.—J. Harrison.
*Commended.*—T. Banks, J. D. Muddiman.

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—Technical World, Invention, Universal Index; also Miner. G. A. H., David Lawn.

J. H. SENIOR.—We have received your letter containing suggestions for competition awards, &c., and will publish same next issue if possible, though we cannot publish much corrrespondence each issue through lack of space.

W. P. LAWS, F. GRAHAM, S. DAVIES, and others.—We thank you for the Examination Results duly to hand, and should have been pleased to publish same if we could have found space. We are extremely pleased to see so many of our readers figuring successfully in the various Examination Reports, several of whom have also gained scholarships and various awards.

## COMPETITION QUESTIONS.

TO the sender of the best set of Original Answers in each Stage will be awarded the following:—
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1.—All envelopes must be marked "COMPETITION."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by August 25th, 1894
5.—The Editor's decision as to winners to be final.

### ELEMENTARY,

*Question 1.*—Give an account of the pillar-and-stall method of working coal. What are the conditions in which this method would be adopted? Give sketches.

*Question 2.*—Describe the method of haulage you would adopt in a mine dipping 1 in 15 from the shaft.

*Question 3.*—What is the quantity and value of 70,430 square yards of coal, three feet two inches thick, at £80 per foot thick per Cheshire acre.

### ADVANCED,

*Question 4.*—Give an account of electric blasting.

*Question 5.*—At what rate per week could a level, six feet by six feet, be driven in granite, coal shale, and hard carboniferous sandstone respectively, supposing manual power is used, and how would you arrange the working force to obtain the most rapid rate of driving?

*Question 6.*—How would you arrange the return of a fiery mine, ventilated by a furnace, to prevent its contact with the fire?

### FIRST-CLASS,

*Question 7.*—Make sketches to show how you would timber roads to resist side pressure, top pressure, and where the bottom lifts.

*Question 8.*—If 50,000 cubic feet of air is circulated per minute by a furnace alone, and 14,000 cubic feet by a steam jet alone, find quantity circulated by both acting together. Also, if 81,000 cubic feet is circulated by furnace and jet combined, find the quantity circulated alone if jet circulates 15,000 cubic feet per minute.

*Question 9.*—How would you arrange for stacked coal being brought back to the heapstead for screening?

*Question 10.*—A hydraulic pump with piston six inches diameter is wrought by means of a head of water, brought from the surface by a one-and-a-half-inch pipe. Find the pressure on piston, and give weight of water in tube. Depth, 70 fathoms.

*Printed and Published by* STROWGER AND SON, Clarence Yard, Wallgate, Wigan.


o 20. Vol. II. SATURDAY, AUGUST 25, 1894. FORTNIGHTLY. ONE PENNY.

## CONTENTS.



# EASY LESSONS ON MINE SURVEYING

**For Beginners.**

*Commenced in No. 2, Volume II.*

## THE MINER'S DIAL.

A GOOD idea of the construction of the miner's dial can be formed by reference to the accompanying illustrations. Fig. 65

A

Fig. 65.

shews the ordinary appearance of the miners' dial. Fig. 66 shews the appearance when taking sights in mines of steep inclination, with an arc attached for taking dip. Fig. 67 is a view of the face or front of the dial, and Fig. 68 the back view.

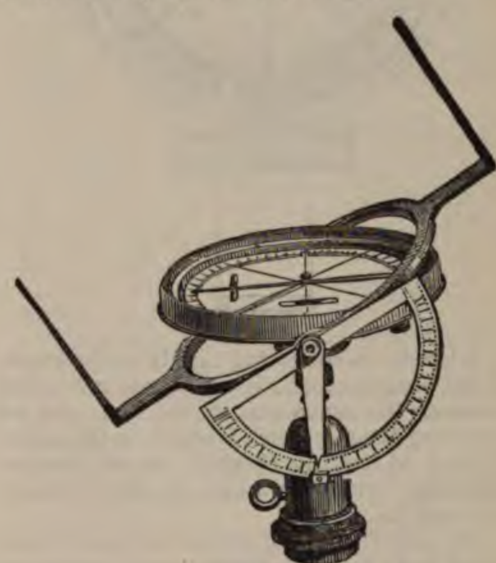


Fig. 66.

It consists of a shallow cylindrical brass box on the inside of which is a raised ring, this ring being graduated into the degrees of a circle, viz.: 360. On this circle the numbers are marked consecutively from 0 to 360; but on the other circle, which is at the base of the box, the graduations are in tens, and are numbered from the north and south of the dial towards the west and east on both sides, thus forming four quadrants of 90 degrees each. At the centre of the box is a vertical finely-pointed pin, on which is suspended a magnetic needle. The needle is slightly shorter than the inner diameter of the raised ring, and its height when swinging freely is such that the

top of the needle is almost on a level with the raised ring, thus enabling the position of the needle in relation to the graduations to be read off accurately.

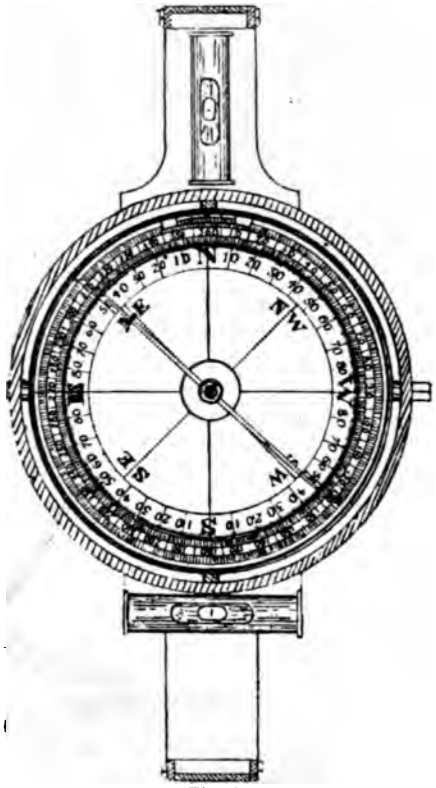


Fig. 67.

A vernier is connected rigidly to the inside of the box, immediately above the graduated circle at the north end of the dial, and by removing the peg which is shewn in the centre of the E. of east (fig. 67 and c, fig. 68), the box with the vernier, etc., can be moved round the circles.

The cap (*a*, fig. 68) fits on a tripod stand which has a ball-and-socket joint to enable the instrument to be levelled. The inner circles are connected rigidly to the cylindrical piece of metal which forms the cap for the legs, and if the dial be first clamped on the legs by the screw (*f*) and the peg (*c*) taken out, the sights can be moved in any direction required by turning the tangent screw (*b*), and as the vernier is in the exact line between the sights, the angle which the sights have been moved through can be found by noting the number of degrees between the centre of the vernier and the north end of the dial. The sights may be clamped in their new position in relation to the graduated circles by means of the screw (*d*).

The bar or lever (*e*) is employed to throw the needle off its seat when not in use, to preserve it from injury. By pushing the lever inwards the needle is lifted up and pressed against the glass which covers the box. When taking a magnetic bearing the lever is pulled outward, and the needle drops back upon its pivot.

The cams (*g* and *h*) only come into use when taking sights in steep places, or when taking dip. By moving them inwards on their centre the sights can be moved in a vertical direction, as shewn by fig. 66. A graduated arc (fig. 66) is fitted to the elongated axis (fig. 68, *k*) of the dial for dip taking.

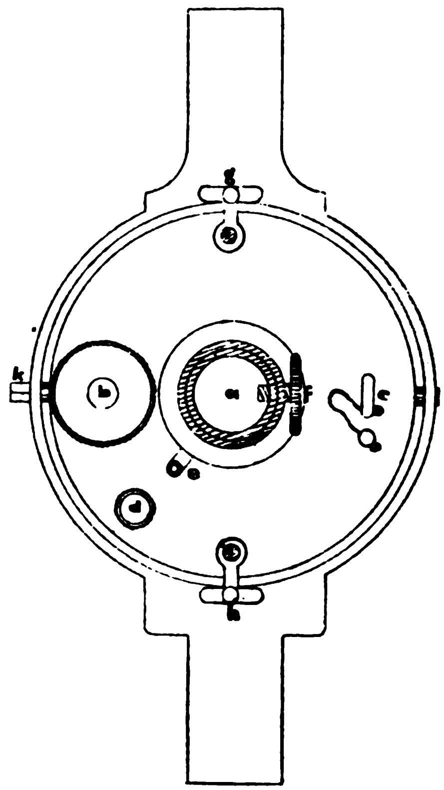


Fig. 68.

The sights—an enlarged view of which is shown by fig. 69—are fixed at the north and south ends of the dial. When in use they are in a vertical position as shewn, but may be folded down for convenience in carrying. It will be seen that one sight has a narrow slit at the top, while the other has a comparatively wide opening, bisected vertically by a horsehair or wire stretched across it. To take a sight the eye is applied to the narrow slit, and the dial is turned round until the vertical hair exactly covers or cuts the

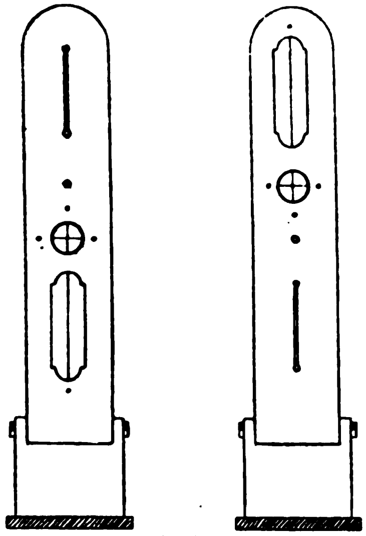


Fig. 69.

centre of the sight object, so that to take a sight from either end of the dial it is necessary to have another pair of openings in the sight vanes, but *vice versa*, and these are shewn at the bottom of the vanes. The small circular openings are used for dip taking, and in this case a horizontal hair is required as well as the vertical one.

Two levels are fitted to the instrument at right angles to each other, so that it may be levelled with facility. Figs. 65 and 66 represent the dial made by Messrs. DAVIS & SONS, of Derby and it will be seen that the levels are placed on the face of the dial, while those of figs. 67 and 68 are shewn near the sights. The mode of attaching to the legs is somewhat different also, but the general principle of all miners' dials is the same.

*(To be continued.)*

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager**

WEST LANCASHIRE & NORTH WALES DIVISION (JUNE, 1893). COMMENCED IN No. 18.

### FIRST CLASS.

### Principles of Mechanics & Machinery (Continued).

QUESTION 10.—Compare the relative advantages and disadvantages of electricity and compressed air when used as a motive power in a mine.

ANSWER.—The advantages of electricity over compressed air when used as a motive power are:—Its first cost is less, can be put in the mine quicker, breakages are easier repaired, and it gives from 15 to 30 per cent. more work for a given horse power than compressed air will give for equal distances, and is considered as safe and efficient when used with the latest improvements. The loss of energy in transmitting electricity from the surface to long distances in the mine is less when compared with the other system, because the escape of the current to the earth is less than the leakage of air from the joints of the pipes in the transmisssion of compressed air, especially in roads liable to heaving and lifting.

Disadvantages are:—The cables are liable to be broken or disconnected by falls. To counteract this the cables are put down of sufficient strength, according to the work to be done, to resist all ordinary disturbances. The great disadvantage which has often been urged against electricity is sparking, which is very dangerous in mines liable to give off explosive gas, but Messrs. STOKES & DAVIES have obviated this by their patent.

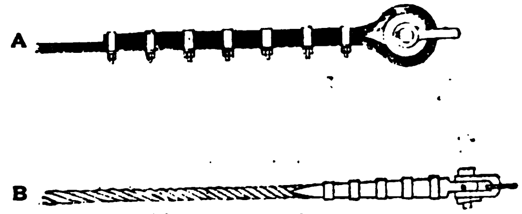
The advantages of compressed air are:—(1) Can be carried and applied to any part of the mine. (2) Improves the ventilation. (3) Absence of heat in conducting the air through pipes, which greatly tends to their preservation.

Disadvantages are:—Heavy cost and low percentage of work obtained.

Therefore, when the two are compared, electricity claims the advantage from its not only being able to be utilised as a motive power but also for lighting the colliery, both on surface and below ground. Also electricity is greatly utilised in our mines for signalling purposes, which far supersedes the older methods of signalling.

QUESTION 11.—Sketch the best form of capping for winding ropes:—(A) Flat ropes. (B) Round ropes (ordinary and locked coil).

ANSWER.—




Sketch A.—Flat rope.
Sketch B.—Ordinary and locked coil.

Question 12.—How would you prepare for a thorough inspection of a large Lancashire boiler, and to what points would you more especially direct your attention in making such inspection?

Answer.—The boiler should be cooled in the first place, and thoroughly cleaned, both internally and externally. All flue dust and soot should be removed from the flues, and the plates brushed clean. Grates and bridges should also be taken out. Internally, the scale or deposit should be removed as far as possible. Man-hole lids to be taken off, and safety valves, feed valves and blow-off taps should be taken to pieces at every thorough examination, aud should be cleaned before being replaced. The following are the points which would receive my careful attention:—(1) Scale or deposit, which, if it is allowed to become encrusted on the plates, not only becomes a danger, but also a waste of power. (2) Corrosion of plates, both externally and internally.

(*a*) Internal Corrosion.—Sometimes the plates below the water-line are reduced in thickness throughout, being a general deterioration of plates. Another form is 'pitting.' This gives the plates affected the appearance of a face having been seriously pitted by small-pox. Besides, the boilers are liable to be affected by internal grooving, which defect is induced by mechanical action, and which will, when the feed-water is of a corrosive nature, spread all the more rapidly.

(*b*) External Corrosion is caused from dampness and leakage. The various safety valves, feed valves, blow-off taps, and all other taps connected with the boilers should be examined thoroughly to see that they are in a good working condition.

### Mine Working.

Question 13.—State in detail the requirements of the Mines Regulation Act with regard to shot-firing in a dry and dusty mine in which inflammable gas has recently been seen.

Answer.—The C.M.R.A., general rule 12, sub-head (*f*):—In any place in which the use of a locked safety lamp is for the time being required by the Act, or which is dry and dusty, no shot shall be fired except by or under the direction of a competent person appointed by the owner, agent, or manager of the mine. Such person shall not fire or allow the shot to be fired until he has examined the place where the shot is to be fired, and all contiguous accessible places of the same seam within a radius of twenty yards, and has found such place safe for firing.

(*g*) If inflammable gas has been reported to be present—in the same ventilating district—at either of the four inspections, under general rule 4, shots shall not be fired:—(1) Unless a competent person (appointed) has examined the place where gas has been so reported to be present and has found such gas to be cleared away, and at or near such place sufficient gas accumulated or issuing to render it unsafe to fire the shot; or (2) Unless the explosive used is of such a nature that it cannot inflame gas, or used with water or other contrivance as to prevent it from inflaming gas.

(*h*) If the place where a shot is to be fired is dry and dusty, then the shot shall not be fired unless one of the following conditions is observed:—(1) Unless the place of firing and all contiguous accessible places within a radius of twenty yards therefrom are, at the time of firing, in a wet state from thorough watering, or other treatment equivalent to watering, in all parts where dust is lodged, whether roof, floor, or sides; or (2) In case watering would injure the roof or floor, unless the explosive is so used with water or other contrivance as to prevent it from inflaming the gas or dust, or is of such a nature that it cannot inflame gas or dust.

(*i*) If such dry and dusty place is part of a main haulage road, or a place contiguous thereto, and shewing dust adhering to the roof and sides, no shot shall be fired unless:—(1) Both conditions mentioned in sub-head *h* have been observed; or (2) Unless such one of the conditions in sub-head *h* as may be applicable to the particular place has been observed, and all workmen have been removed from the seam in which the shot is to be fired, and from all seams communicating with the shaft on the same level, except men engaged in firing the shot, and such other persons, not exceeding ten, as are necessarily employed in attending ventilating furnaces, steam boilers, engines, machinery, winding apparatus, signals, or horses, or in inspecting the mine.

(*To be continued.*)

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# MURTON COLLIERY, DURHAM,

By G. A. HAWES.

(With Illustrations.)

*Specially prepared for "MINING."*

(Continued from last Issue.)

## Winding and Decking Arrangements Continued.

THE surface arrangements (Fig. 5) for the speedy changing of the cages are elaborate, the coals being decked from two levels; the writer has frequently timed the unloading of a cage, and it is done, on an average, in the remarkably short space of 40 seconds. The coals are decked from the higher stage to the heapstead level by means of small cages (fig. 6) constructed to hold one tub and known familiary as 'drops.' Two decks are unloaded at each level, therefore two 'drops' are set side by side for dropping the high deck coals. The small cages are attached to a chain which proceeds over a small vertical pulley to a small drum round which it is coiled a few times; at the other end of the chain hangs a heavy weight, less than the weight of a full tub and greater than the weight of an empty one. The 'modus operandi' of these drops is as follows:—A full tub is run into one of the 'drops,' the brake being then on the small drum, thus making it stationary; the brake is released, when the heavy weight not being sufficient to balance the full tub, the tub and cage descends to the lower level, bringing the weight at the end of the chain up with it; the brake is again put on thus rendering the empty cage stationary at the lower level and ready to receive an empty tub for the higher stage; the brake is again released when the heavy weight suspended in space descends by gravitation, thus bringing the cage to the higher level. An arrangement for making the loaded tub run out of the cage automatically is made by placing a small bunton at the back end of the bottom of the drops, thus tilting the cage at a slight angle.

The shaft entrance is securely guarded by fence gates made of ½-inch iron; the fence

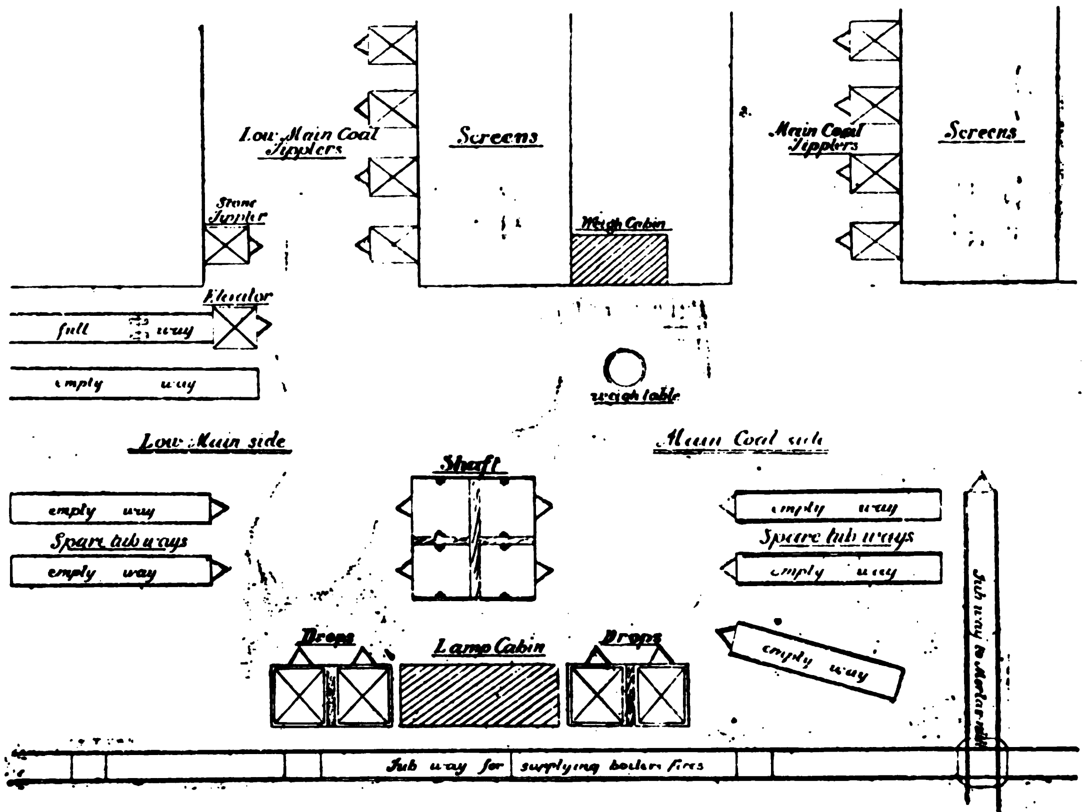



Fig. 5.—PLAN OF SURFACE ARRANGEMENTS.—LOWER FLAT.

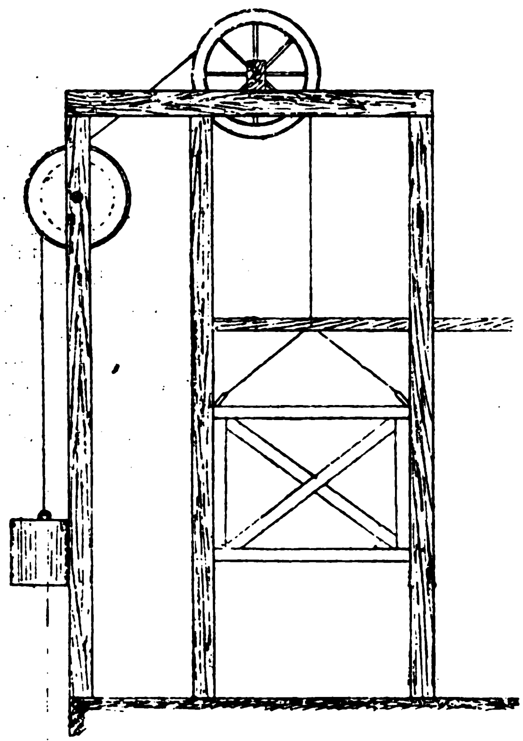


Fig. 6.—Side Elevation of "Drops."

gates are hung upon a horizontal bar of iron; small wheels are secured to the fence gates which run along the horizontal bar, the men sliding them to either side as required by a gentle movement of the hand; these kind of fence gates have many advantages over the gates which are lifted by the ascent of the cage, inasmuch as there is not the confusion made by the clattering of the gate in the cage's descent, the gates never need repairing as do the gates which are worked with the cage, and they are also considerably lighter than the heavy gates of the other method.

A small elevator is situated between the two coal winding shafts for enabling one kind of coal being screened at the two sets of screens in the event of an overplus order for one kind of coal; this elevator consists of a vertical steam cylinder, which, when at the bottom of its stroke, the piston top is upon a level with the heapstead, and at the end of the piston is a hinged platform; steam is admitted to the lower part of the cylinder, the platform is raised with its loaded tub, the tub runs down the inclination made by the hinged platform, and the momentum acquired carries the tub to the other screens. The whole heapstead is covered by a substantial covering of bevelled zinc, which renders it comfortable to the workman in all weathers.

At the shaft bottom the coals are decked from four levels by means of the drops (Fig. 7.) The empty tubs are run into a

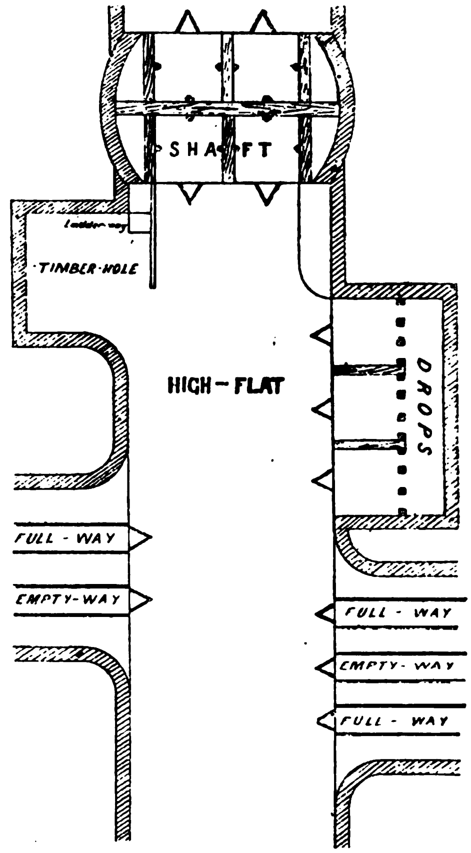



Fig. 7.
Plan of the Uppermost Flat Shaft Bottom.

dish which is inclined inbye, the action of the full tubs is *vice-versa*, the road being inclined for the tubs to run by gravitation towards the shaft. A timber hole is situated at the left side of the shaft for the temporary storage of timber, and near this is the ladder way for the transit from one flat to the other. The flats are covered with iron landing plates.

### Haulage.

The system of haulage is strictly confined to the main and tail rope method in all the seams and with remarkable success. The tubs are square in form made of wood and banded with ribs of ½-inch iron; the couplings are all securely attached to the tub, the method of coupling being by shackle

and pin. The tubs when empty weigh about 4-cwts., and are made with a capacity to hold 10-cwts. of coal. The signalling on the haulage ways is done by elaborate electrical arrangements, and telephones for freely conversing with any person concerned in the haulage of the mine are posted at every station ; even the set-rider is provided with a portable telephone, by means of which he is enabled to freely converse with the person at the nearest station. Six hauling engines situated underground effect the engine haulage, the motive power of all being steam. The other haulage is done by horse drivers and pony putters.

*(To be continued.)*

## ANSWERS TO QUESTIONS

### In No. 17, Vol. 2.

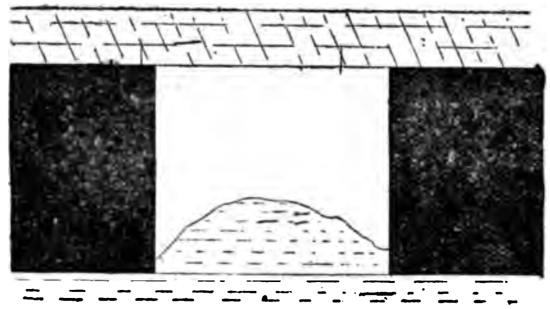
#### ELEMENTARY.

*Question* 1.—What is meant by scaling the air in ventilation, and how is it applied?

*Answer.*—The meaning of scaling the air in ventilation is the setting of a bar about one foot above the horses back, or at any distance, so that the passage of tubs and horses is not stopped, leaving a space of two feet over the bar, with bratticing nailed to the bar and hanging to the floor, so that the current of air is made to rise and scale the bar.

Scaling is applied in mines when large falls occur and fire damp accumulates in the open space above the height of the seam, to force the ventilation, and to keep the place clear. It is also applied in longwall working in the gate-road at the end of the ripping, to keep that end clear of inflammable gases. When the coal is eight or nine feet thick with a parting of dirt, as in the Barnsley bed, the packs are built under the dirt, the top coal is cut along the sides of the middle packs, and an opening is made over the pack into the gob. The ventilation is partly stopped along the face, and is made to scale the pack so as to keep the gob in a working condition until the coal is got out. The timber is then all drawn out and the strata allowed to fall.—Herbert Hall, 15, Yardley Row, Ryhill, Wakefield.

*Question* 2.—Explain, with illustration, what is meant by creep in a mine.



*Answer.*—The meaning of creep in a mine is when the pillars of coal have been left too small to support the weight of the overlying strata, and with the pillars being too small they are forced into the floor. The appearance of the coal sent out to bank after the creep is as if it had been riddled with a half-inch riddle, except at the outside of the pillars they are more at liberty. It not only damages the coal, but the floor is raised up, bars and props broken, until top and floor meet together. Where a 7-feet level has been driven not a week before I have seen the pillars meet each other at the top and bottom as close as if no road was ever made.

The creep also occurs in a mine when the floor is soft and has a hard top or roof. The floor being too soft it is raised, and the coal is crushed into the floor until no road to the coal exists at all. This is my experience in mining operations where it occurs.—Herbert Hall, 15, Yardley Row, Ryhill, Wakefield.

*Question* 3.—Give a brief description of the endless method of haulage.

*Answer.*—There are two methods of endless haulage, viz.:—endless chain and endless rope, but as the endless rope haulage is applied more in mining operations underground the following brief description will be upon that system. The endless rope haulage may be said to be an endless rope passing round the drum of the engine, along one side of the roadway, round a return wheel at the extent of the main engine plane opened out, and back along the other side of the roadway to the drum of the engine. As this haulage requires a wide road two sets or a double road must be laid, so that the full tubs passing out-bye can pass the empty tubs going in-bye. The tubs are attached to the rope by clips at a distance varying according to the supply of full tubs at the main landing, but about twenty yards apart. When branch

roads are at the end of the main engine plane other branch endless ropes may be worked with the rope passing round a pulley driven by the main pulley. It can be made to work other branch roads if required to arrive at the main landing, and the coal hauled to the shaft by the main rope. This is done to reduce horse power. The rate of speed of the endless haulage varies according to the amount of coal raised, but is taken at 3 miles per hour.—HERBERT HALL, 15, Yardley Row, Ryhill, Wakefield.

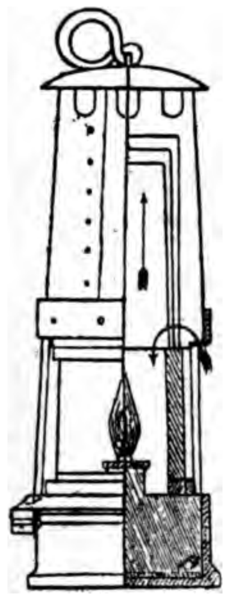
### ADVANCED.

*Question* 4.—How can compressed air be most economically applied to ventilation.

*Answer.*—Compressed air can only be economically and effectually applied for the purpose of carrying on and maintaining an adequate amount of ventilation where the air-compressing plant is already constructed and in use for such purposes as hauling, pumping, driving coal cutters or working rock drills, because to erect air-compressors solely for ventilating levels, drifts, &c., would not be very economical. But, as I have stated, if it is used as a prime mover in hauling, pumping, and coal-cutting machines, &c., then it is one of the best, cheapest, safest, and most economical means yet adopted for ventilation, either in tunnelling or drifting of considerably long lengths, or in the matter of sinking shafts of great depths, and especially if the shaft has to pass through an old goaf of a fiery mine. Again, where a drift, level, sinking pit, or tunnelling is necessary to expedite the work, compressed air can then be used with excellent results, because, in many cases, the compressed air is conveyed through pipes to the drilling machine at the face. These pipes act as an in-take to the level face, and the level itself acts as a return airway. Compressed air has been preferred to the common mode of erecting a brattice to make an intake and return. The principal advantages in the matter of economy in its use for ventilation are as follows:—(*a*) In drifting, etc., where the ventilation is so imperfect and where it is impossible to employ any other motor, compressed air can be cheaply and quickly used and employed. (*b*) It can be used to supply direct power to the drilling machine to drill the holes. (*c*) The exhaust air assists the ventilation. (*d*) It supplies a constant fresh current for the workmen at the face, both for respiration, lighting and blasting purposes. (*e*) Compressed air can be carried to any part or points of the mine without doing the least damage or danger.—SAMUEL DAVIES, Park Road View, Worsbro' Bridge, near Barnsley.

*Question* 5.—Give sketch and description of what you consider to be one of the best safety lamps.

*Answer.*—The "Marsaut" safety lamp is the one I consider to be the best and safest lamp. It is an improved 'Clanny' with two chief improvements, viz.:—Instead of one gauze cylinder there are two and sometimes three one inside the other. These gauzes fit one within the other at their bases on the top of the glass cylinder, gradually inclining from each other towards the top, and the glass cylinder surrounds the flame. The other improvement is that the gauzes are shielded by a sheet-iron cylinder called a bonnet. The arrows on sketch indicate the air feeding the flame and then ascending with the gases given off from combustion, and escaping at the top through a series of holes in the circular shield of the lamp. The above lamp is very largely used, it being considered a very safe one. It is safe in a current up to a velocity of 40 feet per second, the light going out in an explosive mixture, this being the chief point why it is safe in the hands of many practical miners.—GEORGE DAYKIN, 24, High Gurney Villa, near Bishop Auckland.



*Question* 6.—How would you arrange the arching at the bottom of a mine where the strata at top and bottom was soft?

*Answer.*—I would build an inverted arch on which to rest the main arch: this would resist greatly against the bottom pressure. The top being soft and weak also I would construct the main arch in the shape of a horse shoe. I would build all the arching throughout the weak strata extra in thickness,

viz.:—about 27 inches, and use very little mortar at the joints. The timber which protects the workmen while building the arch should be withdrawn, and the space between the arch and the strata carefully packed with sand, so as to distribute the pressure evenly upon the arch. If there are any good stone quarries about the surface, it would answer well to have them dressed purposely for the inverted arch, because they would make a splendid foundation for the main arch which is built with fire-bricks, they being easily made and are plentiful at most collieries.—GEORGE DAYKIN, 24, High Gurney Villa, near Bishop Auckland.

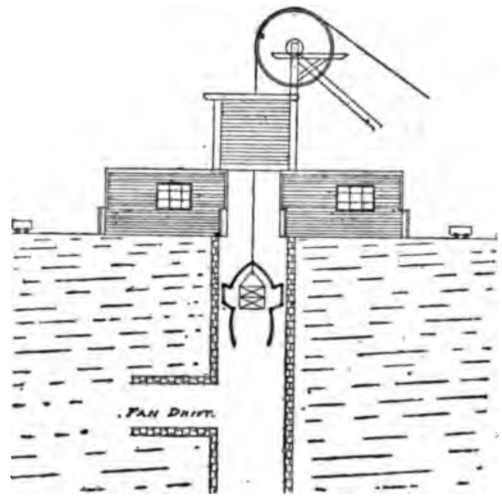
### FIRST-CLASS.

*Question* 7.—Give a brief account of the duties of a colliery manager.

*Answer.*—The chief duties of a colliery manager are to attend to all the regulations and rules of the Coal Mines Regulation Act, such as keeping all books, plans and registers, and reporting to the Mines Inspector all accidents and explosions of any nature whatever. He is also responsible for the yearly returns to the Inspector, and as he is responsible for the control, management and direction of the mine, it is necessary that he should appoint deputies and other responsible persons competent to see that the Mines Act is properly enforced. He must also lay out and arrange the workings according to the output required, and direct the system of working with a view to safety to the workmen and economy to his master. Daily personal supervision of the mine is required by the Act, and he shall settle all prices and any disagreements which may arise among any of the men under him. He should also see that all orders for timber or other appliances are attended to, and examine the various reports daily, weekly and monthly, so that anything which might require it shall receive his due attention, with a view to the economy and profit of the company.—ALEX BAILLIE, 47, Pitt Street, Newton, near Glasgow.

*Question* 8.—Explain, with illustration, how you would arrange for winding at a fan pit.

*Answer.*—I should say that as it has to be an up-cast shaft that it be bricked throughout, as return air has a disastrous effect on timber. I would have it a circular pit, which would give more space for ventilation, and I would use rope guides, having no wood in the shaft if possible. I would have double doors at the surface, to open either way by springs. The




top doors would lift with the ascent of the cage, and this would cause the bottom ones to close. The rope passes through the centre of the door and is encircled by a small lid which is movable, and thus saves the rope from splitting the door. I think the accompanying sketch will show the arrangement quite clear.—ALEX. BAILLIE, 47, Pitt Street, Newton, near Glasgow.

*Question* 9.—Are the Examinations for First-Class Certificates of Competency, in your opinion perfect? If not, what alterations would you suggest?

*Answer.*—In my opinion they are not perfect in so far that they are too theoretical in some of the subjects. At least I would introduce a new subject treating on the various occurences that are likely to take place in every-day labour, such as an explosion of firedamp, coal dust, or something of that nature; or part of the shaft subsiding, a great fall of roof and perhaps some workmen entombed—all of these are likely to take place any moment, and require great skill and tact at the time being, which could be facilitated to a great extent by making the manager pass an examination on this alone. Also, another of the many points which in my opinion require consideration is the fee payable:—£2. I cannot see how it requires such a fee from any candidate who sits to defray exam. expenses. So that in the event of a man failing with first trial I would give him some encouragement to go on by

reducing the fee for him. Then when a man sits for a first-class and fails, if he is worthy of a second-class, why not let him have it? And I would say by all means let a candidate have good time to do his work, except in arithmetic, because I know from personal experience that there is plenty of valuable matter lost entirely for the want of time to explain it. This I believe would give practical men a little more chance.—ALEX. BAILLIE, 47, Pitt Street, Newton, near Glasgow.

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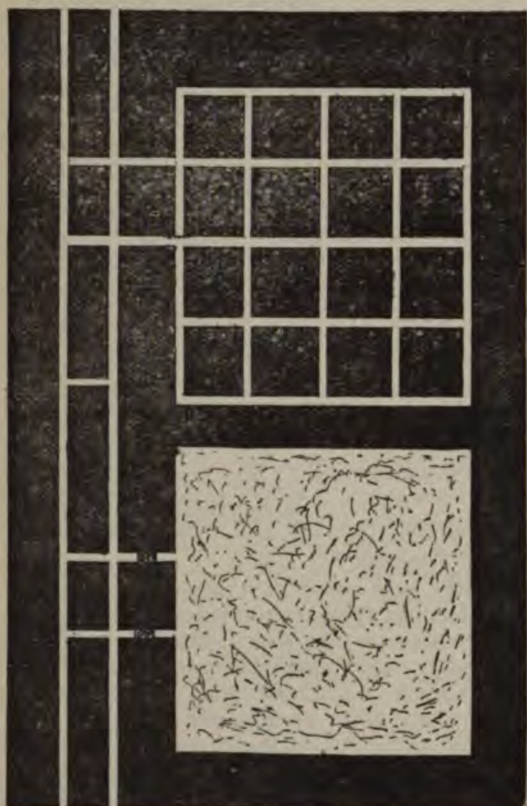
*Question* 10.—Shew, with illustrations, how you would work a seam of coal subject to spontaneous combustion?



*Answer*.—This is a broad question and would admit of a very lengthy answer, as the system of working would depend entirely upon the circumstances attached to each special case. For example, it would not be advantageous to work a thick seam on the long-wall system; neither would it be to work a thin seam on the stoop-and-room principle. But, for seams which would offer a disadvantage to the long-wall system, and were suitable, I would adopt stoop-and-room (bord-and-pillar), and work it on the panel system by driving out two narrow places to the boundary, with perhaps 20 yards stoop between, and connected at suitable places for the ventilation a pair of roads would be started off these, at right angles, every 200 yards. After these places have advanced 40 yards places could be started every right and left until the roads were up as far as made a square panel. After this was formed the stoops would be started at the top and brought back, leaving nothing but a square panel of gob. Then it should be securely sealed off at the entrance to allow it to damp down and prevent gob fire.

Seams which would suit long-wall system I would take very short walls, say 12 yards, and take as much brushing down as would make packs right through, and make the whole a solid pack. Between the roads (gate-ways) take out every possible particle of coal, and also remove all broken timber. Keep up a good supply of ventilation through the workings, and after the stope roads (or main roads) were finished I would also seal them off to prevent gob fires. If the seam does not yield as much refuse as will make these packs it may be brought from the other seams.—ALEX. BAILLIE, 47, Pitt Street, Newton, near Glasgow.

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## AWARDS

FOR ANSWERS TO QUESTIONS IN THIS ISSUE.

ELEMENTARY.—H. Hall.

*Commended.*—J. T. Ward, J. H. Berry, J. Deakin

ADVANCED.—G. Daykin.

*Commended.*—S. Davis, B. Nightingale, J. Stephenson, A. Alderson, T. Lawrenson.

FIRST-CLASS.—Alex. Baillie.

*Commended.*—J. McPhail, R. Holcroft, J Harrison, J. J. Lewis.

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## COMPETITION QUESTIONS.

TO the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d.**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best answer to each question will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."

2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3.—Correct name and postal address must be sent.

4.—They must reach us by September 1st, 1894.

5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—What are bituminous, free-burning, and smokeless coals? Give an example of each.

*Question* 2.—Describe, with illustrative details, the general structure of a coalfield.

*Question* 3.—Describe and illustrate the use of timber in securing a round or rectangular mine shaft.

### ADVANCED.

*Question* 4.—What methods have been employed to prevent flame in the use of explosives in collieries?

*Question* 5.—Describe, with suitable sketches the diamond method of rock boring.

*Question* 6.—What methods are used for equalising the load on winding engines? Give sketches.

### FIRST-CLASS.

*Question* 7.—How is creep and thrust brought on, and what would you do to prevent it?

*Question* 8.—Describe, with sketch, how you would win the pillars in a mine subject to creep, or over which creep has passed?

*Question* 9.—What percentage of coal would you take out at first working a seam at 60, 150, and 200 fathoms, average roof and pavement? Give size of stoops and width of rooms you would adopt to get the largest amount of coal possible, consistent with economy and safety?

*Question* 10.—Sketch and describe some methods of working highly-inclined coal seams.

*Answers to above will appear in No. 23.*

## THE FACILITIES OF ADVANCEMENT PRESENTED TO MINING STUDENTS.

WE doubt if there is any employment in this country in which such opportunities of advancement present themselves to the younger employees as does the mining industry.

With the present facilities afforded of learning the scientific and practical part of the subject, every enterprising and persevering student, no matter what his social position may be, can obtain a Colliery Manager's Certificate, the obtaining of which enables the holder to get a better salary than he would have done otherwise, even if he does not become a full-fledged manager at once. Thirty years ago it was the persevering, steady and long-headed workman who obtained the post of Colliery Manager, and many have succeeded so admirably in their position that they are in receipt of incomes at the present time amounting to several thousands per annum, although many of them knew barely the elements of reading and writing when first appointed. In those days, and in comparatively recent times, mining literature was difficult to obtain—almost inaccessible to the working man—and his personal experience of his own and neighbouring collieries, and his own tact and ingenuity had to tide him over difficulties, without being able to ascertain what had been done in similar circumstances at other collieries. At the present time, however, the poorest of workmen can obtain a thorough knowledge of the various methods and arrangements employed to accomplish certain ends by referring to the descriptions of other collieries, which may be obtained from some of the cheap reliable text books which are now published, or from periodicals like our own. It is true that every one employed in the mining industry cannot become a Colliery Manager, but we wish the majority of our readers to aim for that end.

An oft'-repeated cry of miners a few years ago was that it was useless for a working man to obtain a Certificate, as it was only the favourites or relations of the colliery proprietors who obtained the positions. This may have been the case in some few instances, but recent appointments seem to refute this statement, in fact, in many cases preference is given to the possessor of a certificate who has worked for a considerable time. We would, therefore, advise our readers to persevere in their studies, and miss no opportunities, and their position at some future date may excel their brightest dreams.—EDITOR.

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—Colliery Engineer, Technical World, Invention, Universal Index, Jno. Harrison, D. Lawn, Elementary, and S. Finch.

AN AMATEUR.—We will publish a short article on the question asked by you, viz., "Wire Rope Splicing" in an early issue.

E. ASHLEY.—We quite agree with you that the description of Murton Colliery is very unique, and this is one of the principal reasons why we have published an account of it. It is our endeavour to bring before our readers new departures and arrangements which are working successfully.

COMPETITOR.—Illustrations should not be in colours but in indian ink only.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

- To be written on one side of the paper only.
- Envelopes to be marked "Correspondence."
- Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.
- Correspondence must not be enclosed with Competition Answers.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### Timbering.

Sir,—I take the following extract from the successful answer to Question 8, in No. 18, Vol. II.:—"(8) If the timber be made for a bar or baulk and, as is often the case, has a round side, then the round side should, where practicable, be put next the roof, thereby increasing the strength of the bar."

Now in my opinion this statement is very misleading, especially to that section of your readers who, like myself, look in the columns of "Mining" for genuine and reliable information. For my own part, and according to my own observation, I should expect results directly opposite to the above. For instance, let us take a round bar of timber; it is now in its strongest state, but suppose we saw a thin strip off one side, as is usually done with mine timber for convenience in setting, then, unless the timber is perfectly straight-grained, we shall find that the fibres of the wood have been cut through, and the ends are exposed all along the flat surface. If such a bar were set with its round side against the roof, the fibres of the wood would begin to splinter out immediately the bar began to bend, thus causing a great loss of strength in the timber. The timber for square baulks should be selected as nearly straight-grained as possible. A competent man should also be appointed to decide which side shall be fixed uppermost, as one side is almost sure to contain more broken fibres than the other. In the case of bars which are slightly bent, and which are usually sawn on the concave side, then the round side may be set against the roof, as the bend in the bar forms a natural arch, the increased strength of which more than compensates for the loss of strength in the sawn fibres.

I think I have managed to make myself clear on this point, but I do not say that all I have written is right. I only give the results of my observation, and your correspondent is as likely to be right as I am, and I hope he will not take exception to this little friendly criticism.

Hoping some of your readers who are practical timbermen like myself will give their opinion on this subject. MINING STUDENT.

### Mining Problems.

Sir,—I am obliged to you for the insertion of my last questions, also to Mr. Spence for his answers. I believe there has been a printer's error in the weight of coal as given in the answer. Please insert the following: **(1) There were 20,000 gallons of water in a mine, the depth of which is 120 yards, when an engine, 80 h.p., began to pump the water which was cleared after 5 hours' pumping. How many gallons of water had run into the mine per hour, assuming the engine to give 66 per cent. of useful effect. (2) What is the weight of a cubic foot of coal? (3) What is the best kind of drilling tools for boring against old workings (in the coal), their sizes, price, and the usual cost for labour? (4) What is the breaking strain of a $\frac{3}{4}$ hauling rope, also $\frac{5}{8}$ iron made into tub links.**

Thanking you in anticipation. OVER HULTON.

### A Reader's Opinion.

Sir,—"Mining" is the best and cheapest of mining papers. I am highly satisfied with it. I like your newly-arranged system, as it is most suitable for me, as I live out in the country and very often get my paper late on in the following week. I read with interest the matter it contains, and I may say that it has been of much help to me in my late and successful examination for Second Class Colliery Manager's Certificate, at Leeds (June Examination) held at the Town Hall. I have taken your paper from its commencement, and though I have not often sent in worked questions I never miss the opportunity of working them at home. ED. ISAAC.

### Boilers.

Sir,—I wish to submit the following answer to "A Young Engineer's" question in No. 15, of Vol. II. An upright boiler of the following dimensions, viz.:—Three feet diameter, ten feet high, with 60lbs. pressure per square inch; what would be the horse-power, and show how you would work it out in figures.

In the first place it is usual to find the number of square feet of heating surface and seven square feet of heating surface to one horse-power for vertical boilers. In order to do this you want the size of the fire-box and up-take tube, also whether there are any cross-tubes in the up-take tube or not. The question as given does not state these particulars, therefore I will take a proportion which is used in the construction of some vertical boilers and considered to be a fair proportion.

Dimensions of vertical boiler and up-take tube, no cross-tubes:—

| Boiler. | Fire-Box. | | Up-take Tube. |
|---|---|---|---|
| Length. | Length from bottom seam to crown of fire-box. | Mean Diameter. | Diameter. |
| 10ft. | 3ft. 3in. | 28in. | 9¾in. |

$28 \times 3{\cdot}1416 = 87{\cdot}9648$ inches, perimter of fire-box.

$87{\cdot}9648 \times 39$ inches (height of fire-box) $= 3430{\cdot}6272$ sq. inches of heating surface.

Height of boiler $= 120$, therefore height of up-take tube $= 120 - 39 = 81$ inches.

$9{\cdot}75 \times 3{\cdot}1416 = 30{\cdot}6306$ ins. perimeter of up-take tube

$30{\cdot}6306 \times 81 = 2481{\cdot}0786$ square inches of heating surface in up-take tube.

$\dfrac{3430{\cdot}6272 \times 2481{\cdot}0786}{144} = 41{\cdot}0535$ sq. feet of heating surface.

Therefore, as we reckon seven square feet of heating surface to one H.P. we have the following result:—

$$\text{H.P.} = \frac{41{\cdot}0535}{7} = 5{\cdot}8647.$$

Hoping this may help "A Young Engineer" and other readers of this paper to work out similar examples. C. K. A.

Printed and Published by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MIN[ING]

o 21. Vol. II. SATURDAY, SEPTEMBER 8, 1894. FORTNIGHTLY. ONE PENNY.


## CONTENTS



## EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in No. 2, Volume II.*

### THE ATTRACTIVE POWER OF IRON OR STEEL ON THE MAGNETIC NEEDLE.

WE presume that the construction of a miner's dial, as explained in our last article, is thoroughly understood by the student, and will now describe how observations are taken. Previous to doing this, however, we must mention an important phenomenon of the magnetic needle which must receive attention when using the instrument.

When iron or steel is brought into close proximity to the magnetic needle, the needle is attracted towards it. For example if a knife blade be held near the glass cover of the dial, the needle will deviate from its true position and move towards the blade. It is therefore apparent that a true observation cannot be made with the needle in the proximity of iron, and this is a source of difficulty in the mine, as it becomes necessary to take up the tram rails and remove them from the place where the dial is to be used, or make what is known as a "fast needle" survey.

The distance to which the iron should be removed depends upon how sensitive the needle is, but for ordinary circumstances it will be found that four yards on either side is sufficient. If the observation is an important one, or one upon which the remainder of the survey depends, it may be found advisable to increase this distance to six yards.

To guard against the needle being attracted care must be taken that the lamp used is constructed of non-magnetic metals. The lamp usually employed is constructed of brass with copper gauzes, and is locked by means of lead rivets.

### TO TAKE AN OBSERVATION WITH THE MAGNETIC NEEDLE.

Having first assured yourself that there is nothing to attract the needle in the locality chosen, set the tripod of the dial firmly on the floor, placing the dial on it. Remove the cover from the face of the dial and adjust the instrument to a truly horizontal position, which can be ascertained by means of the spirit levels attached, and drop the needle on its seat. The needle will now oscillate from side to side of its true position, the oscillations gradually becoming less until the needle at length stops exactly in the magnetic north and south line.

While the needle is oscillating the sight may be taken. Turn the dial round until the N end is towards the sight object, which in the case of an underground survey is a lamp, and with the eye applied to the narrow slit at the S end, adjust the dial until the vertical hair in the corresponding sight of the N end exactly cuts the centre of the flame of the sight lamp, and clamp the dial in this position on the legs by means of the screw.

The needle having now settled, the position of its N end is read off from the inner graduated circle.

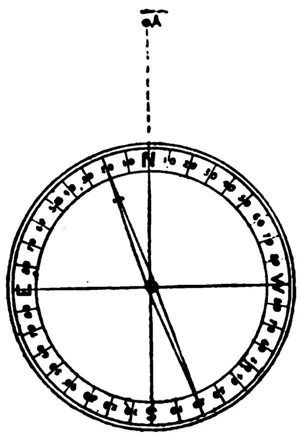

Fig. 70.

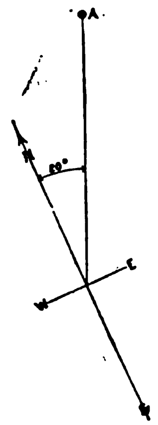

Fig. 71.

Fig. 70 is intended to represent a dial face, and here it will be seen that the E and W are on the contrary sides of N and S to the geographical position. The reason of this will be understood from the Figs. 70 and 71. The N and S of the dial are placed in the line of sight; the sight object being A, and the needle then reads N 20° E on the dial. Now the direction of the needle is the magnetic meridian, and the line of sight is 20° to the right, that is to the east, therefore the magnetic bearing of this line is N 20° E. This is shown more clearly by Fig. 71 where a line is drawn to represent the magnetic meridian, and another line is drawn to coincide with the direction of the sight. It is now apparent that the sight line is north-east, but if the letters E and W were put on the dial face in their ordinary position, the bearing would read N 20° W which is inaccurate. The circumstance which causes this peculiarity is that it is the position of the needle which is read off with relation to the sight line, and not the sight line to the needle, that is the meridian; the needle being always in the same direction and the face of the dial being moved about it.

In the mariner's compass a graduated card is attached to the magnetic needle, and the N and S line of the graduated circle is thus, the magnetic meridian and the necessity of transposing the letters E and W is obviated.

As a further example, say the hour hand of a clock points to six, and that instead of the hand moving, the clock face moves in the same direction and speed as the hand usually does. Then after a lapse of three hours the hand of the clock having remained immovable will point to three instead of nine. To make the clock read right in this case, it would be necessary to count the figures from left to right similar to the manner in which the face of the dial is altered.

*(To be continued.)*

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### The Welsh Colliery Disaster.

At the conclusion of this inquiry, the jury after four hours' deliberation, returned a verdict that the disaster was due to a gas explosion, accelerated by coal dust, but they disagreed as to its origin. The jury considered that shot firing was practised in the mine, whilst the men were at work, without sufficient precaution as to their safety, and contrary to rules, they were also of opinion that the under-manager neglected his duty in not seeing that his subordinates in the night shift performed their duties in accordance with rules, that the firemen were negligent in not reporting gas when found, and that there was not a proper system of watering in the mine. They recommended that shot firing in timber should be absolutely prohibited, that all old workings should be properly stowed or gobbed, that a record should be kept of the number of men in the mine, and that a thorough inspection should be more frequently be made by the mine inspectors, as the present workmen's examinations are worthless.

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## EXAMINATION QUESTIONS,

WITH ANSWERS BY

**JOSEPH CARTER, First-Class Certificated Manager**

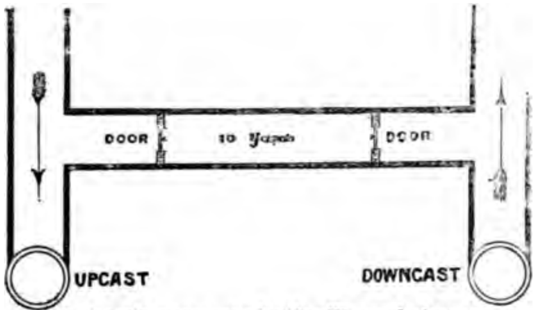
West Lancashire & North Wales Division (June, 1893). Commenced in No. 18.

### FIRST CLASS.

#### Mine Working.—(Continued.)

Question 14.—Give a sketch of the way you would build in a pair of air doors between the intake and return airways of a mine, with dimensions.

Answer.—Doors to be 5 feet high by 4 feet wide, built so as to open against the current and of such a distance apart as to leave a space between of several yards, so that one can be shut whilst the other is opened.—(Elevation of door in No. 3, Vol. II.)



Plan shewing communication Doors between Shafts.

QUESTION 15.—What is the duty of a Manager with regard to—

(a) Ventilation
(b) Notices
(c) Discipline

ANSWER.—(a) The duties of the Manager with regard to ventilation, is to see that an adequate amount is constantly supplied in accordance with C.M.R.A. General Rule 1, which says, "there shall be constantly producing in every mine, such an amount of ventilation as to dilute and render harmless noxious gases to such an extent that all working places, levels, stables, and workings of the mine, and the travelling roads to and from these working places, shall be in a fit state for working and passing therein."

The quantity of air passing in each of the respective splits shall be measured and recorded in a book at least once per month, which the Manager must see is carried out.

(b) Notices such as are required by the Act must be posted up, and the Manager must see that they are attended to. The following is a summary of notices required by the Act:—

Notices of accidents of loss of life or serious personal injury, together with nature of accident; of explosions, abandonment and commencement of mines, notices of stations in the mine, before commencement of shift, lamp stations, notices specifying the regulations of work people on surface, number of persons to ascend and descend at one time. Such notices as these should be posted up in a conspicuous place for the guidance of persons employed.

(c) Discipline.—The duties of a Manager with regard to this is that he should enforce the obedience of all officers and men under his charge, that whatsoever instructions he gives will be carried out and strictly observed, and any one failing this should be punished for the offence. If the Manager will only enforce a thorough obedience in regard to the C.M.R.A. by all under him, these accidents will have a tendency to diminish, because it is by a laxity of discipline at times that many accidents arise

QUESTION 16.—To keep back a feeder of water met with in a tunnel 7 feet × 5 feet, 150 yards from the surface, what sort of dam would you put in? Give sketch, and describe how you would proceed with the work.

ANSWER.—I should put a wooden dam in and proceed as follows:—First, I should select a place free from steps or breaks of any kind, dress the roof floor and sides perfectly smooth, and this must be done with pick, hammer and wedge. Shots of any kind must not be fired, because they shake the sides and cause breaks. When the sides, top and bottom have been thoroughly dressed, I should put a layer of tarred flannel next the floor, sides and top, and then pieces of wood are built up. The wood most suitable for such work is good, sound and well-seasoned oak, say in 8 feet lengths, square and tapered to the radius of the width of your place when dressed. The pieces of wood are laid down in rows besides each other, and one upon another, the larger ends placed towards the water. In the process of the work I would insert three metal pipes as I proceeded with the building, one of which I would place about a foot from the bottom and of such a size as to allow the water to run through, and if a great quantity of water was made two such pipes might be inserted. About 2 feet from the bottom I would insert another pipe 18 inches diameter, this is to allow the men to pass through while the dam is in building and wedging, because the wedging must be done on the side from which the pressure comes, which is on the inside of the dam. Then I would insert another pipe about an inch in diameter near the roof; the pieces of timber are all prepared on the surface, fitted accurately together there, and each piece is numbered before being taken into the mine.

I would convey all the water to the pipe or pipes in the dam, and having built up all the pieces I would then proceed with the wedging process from the inside using fir wedges, 12 inches long and at least 3 inches broad, about an inch thick at the head; after these have been driven in at all the joints and round the pipes smaller oaken

wedges may be driven, using an iron chisel to prepare places for their insertion. When I could not drive any more wooden wedges in, I would get a few steel ones and drive as many of these in as possible. When I had completed the wedging, I would drive a plug which had been prepared for the purpose into the water pipe (the one nearest floor). The upper pipe must also be plugged in the same way, or if practicable, would carry the water by means of iron pipes to such a level as will outset the water. The workmen would then pass through the middle pipe and draw after them a plug that has been prepared beforehand and carried in before the erection of the dam; this plug should be covered near its larger end with vulcanized india-rubber, so as to ensure a water-tight joint with the pipe, this is drawn in by means of a rope, and can be tightened by means of a windlass or a rope attached to a lever. The pressure which comes to bear on the dam will force the plug more firmly in the pipe. (Sketch in No. 10, Vol. II).

*(To be continued).*

## COMPETITION QUESTIONS.

To the sender of the best set of Original Answers in each Stage will be awarded the following :—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d.**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best answer to each question will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."

2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3.—Correct name and postal address must be sent.

4.—They must reach us by September 22nd, 1894.

5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—How is the stuff drawn in small shafts underground not communicating with the surface? Give sketch.

*Question* 2.—What kinds of ropes are used in mines? Discuss their efficiency and the work to which each is applied.

*Question* 3.—What is ascensional ventilation?

### ADVANCED.

*Question* 4.—Explain with sketch and show the ventilation of a method of longwall with which you are acquainted?

*Question* 5.—What are the conditions upon which you would advise working longwall and what are its advantages?

*Question* 6.—Describe with sketches the usual surface plant of a sinking pit.

### FIRST-CLASS.

*Question* 7.—If a heavy fall occurred which entombed several men, how would you proceed to liberate them?

*Question* 8.—How many gallons of water will a pump of the following dimensions throw in twelve hours, allowing 10 % for loss. Diameter of pump, 18 inches; length of stroke, 8 feet; number of strokes per minute, 8?

*Question* 9.—Sketch and describe what you consider to be the best method of working to the rise a "fiery" seam of coal 5 feet thick, dipping 1 in 7, with the following section of roof and floor :—

| | |
|---|---|
| ROOF—Strong cliff, 4ft. | FLOOR—Fireclay, 1ft. |
| Clod, 1ft. | Hard cliff, 2ft. |

*Question* 10.—State what gradients with or against the load you would prefer for endless rope and main and tail rope haulage, and give your reasons?

# MURTON COLLIERY, DURHAM

BY G. A. HAWES.

(With Illustrations.)

*Specially prepared for "MINING."*

(Continued from last Issue.)

### PUMPING.

THE colliery makes a considerable amount of water and this is dealt with by a variety of pumps. In the Hutton seam, which is the deepest, is placed an hydraulic pump which is most economical in its action, inasmuch as the attention of a man for only half-an-hour each day is required, and this for the purpose of lubrication with an extremely cheap lubricant—soft soap; this pump delivers its water into the main standage in the upper seam. A syphon drains part of the upper seam into the main standage. Several pumps are worked by the tail rope of the haulage engines. An electric pump with its power transmitted from a dynamo at the surface by two wires, also delivers its waters into the main standage. Hand pumps are brought into requisition for draining the water from the workings into the sumps of the syphon and tail-rope pumps. Water-tubs are employed for draining small quantities of water from the working faces, their contents being discharged into the nearest sump of the locality. All the water is discharged into one main standage where it is forced to the surface by a powerful forcing engine.

### VENTILATION.

The entire ventilation of the whole colliery is produced by one large furnace, which, owing to its being situated at the bottom of the upcast shaft (west shaft) which is used only for the discharge of the furnace, no experience of injury to winding ropes, pump pipes, etc., is felt. The shaft has ascending in it 400,000 cubic feet of air per minute, and Mr. Bailes, Mining Engineer, says he can vouch for this quantity of air, he having personally measured it several times.

Owing to the extremely sulphurous fumes discharged by the furnace it was found some years ago that the cast-iron tubbing was showing signs of weakness and decay, indeed, it was said that in some places it could be penetrated with a small pen-knife, so it was decided to re-tub the shaft; the old tubbing could not be taken out, therefore, a new column of tubbing had to be built against the old. The segments of the new tubbing were 2 feet deep × 4 feet wide, and made of three different thicknesses. The portion on which the most pressure was exerted, viz.: the bottom, was 2 inches in thickness, the middle portion was 1½ inches in thickness, the top portion 1 inch in thickness. In order to prevent the decay of the new tubbing, it was divided into eight divisions by brackets, and inserted into each of the divisions was a fire-clay lump 9 inch square × 2½ inch thick, and secured by cement before being sent down the shaft. It was found by the insertion of the new tubbing that the shaft diameter was reduced to 13 feet 10 inches. This shaft has again been lined with a lining of bricks which just attained completion last month; the work has taken seventeen months to finish, and the pit has never lost a day's work through it, the furnace being damped out at the week-ends for the purpose. A new chimney is at present being erected over the old one, and is to be of a larger diameter and a greater height, thus lengthening the motive column and producing more efficient ventilation. Splitting of air is very prevalent at the colliery and is attended with very good results.

### SURFACE LIGHTING.

The lighting on the surface at the branches, patent screen and travelling belt, offices, and elevators is the electric light. The electric light is generated by one of HOLME'S Shunt Wound "Castle" dynamos with a capacity of 156 amperes at 120 volts. H.P., 25. The output of the dynamo is 127 amperes at 120 volts (h.p. 20½) and is distributed as follows:—10 double-arc lamps of 1,000 candle power each, and 68 incandescent lamps of 16, 25, and 32 candle power respectively. The dynamo is worked on the third motion by a leather link belt passed round a four-feet wheel keyed to a countershaft worked on the second motion by a canvas belt from the fly-wheel of a horizontal engine. The dynamo is by this arrangement worked at 820 revolutions per minute.

The dynamo is driven by a horizontal engine built at the shops of the Company at South Hetton, under the superintendence of the chief engineer, Mr. BURNETT. The engine can be

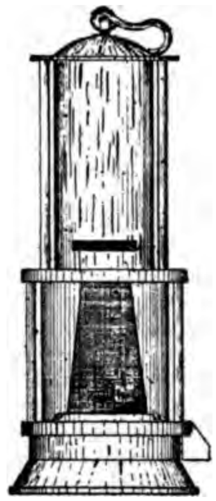
either worked at high pressure or condensing, as required for the various requirements it has to perform. The dimensions of the engine are as follow:—Cylinder, 18 inches by 2-feet stroke; fly-wheel, 8 feet in diameter; revolutions, 81 per minute; steam pressure, 50 pounds on the square inch. The engine is constructed to pump water when necessary, and it is also utilised as a fire-engine in the event of a fire occurring in the neighbourhood of the colliery, the hose pipes and all accessories being kept in readiness at the engine house, a plentiful supply of water being available from the reservoir of the delivery of the forcing engine. The countershaft is on this account provided with a clutch to throw the dynamo driving wheel out of gear when required.

Part of the heapstead, the workmen's shops, lamp cabin, etc., are lighted with gas manufactured on the premises by the company's gas works.

### Underground Lighting.

At the shaft bottom the illuminant used is gas. The workmen on the main engine plane way are provided with the "Marsaut" lamp with the double gauze. I might mention that this lamp—acknowledged to be the typical safety lamp—is not allowed at the faces, inasmuch as the workmen are prejudiced against it, for in the event of a glass being broken the "Marsaut" becomes dangerous. The face workmen are provided with other safety lamps applicable to the various seams. In the Main Coal, Low Main, and part of the Hutton seam the "Donald" lamp is used which is a very safe lamp. It is a highly-modified form of the "Davy" lamp, the gauze being bonnetted and surrounded by a glass cylinder.

In a faulted part of the Hutton seam worked from the Low Main level, which is very fiery indeed, an excellent form of safety lamp is used called the "Routledge-Johnson" lamp. This lamp is what might be called a combination lamp, inasmuch as in it are the combined virtues of the "Davy," "Marsaut" and "Meuseler" lamps. Over the upper portion of the lamp is a brass cylindrical bonnet with the intake air-holes at the base. Inside this proceeds a gauze, as in the "Marsaut" and "Clanny" lamps. Inside this gauze is inserted a funnel chimney perforated with holes, resembling the funnel and perforated diaphram of the "Meuseler," and a small gauze proceeds as in the "Davy" lamp into this funnel. If the glass of the "Marsaut" or "Meuseler" lamp became broken we have at once a naked light totally unfit for a fiery seam,



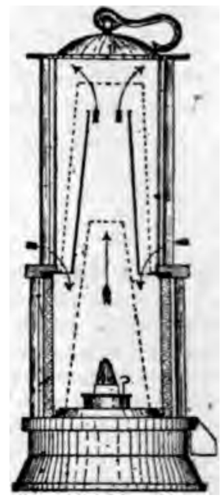


**Fig. 8—Elevation. Fig. 9—Cross Section.**
**Routledge Johnson Safety Lamp.**

but should the glass of the "Routledge-Johnson" be broken we have still a safety lamp—the "Davy." On the whole, the lamp is an excellent type of safety lamp, but is open to one improvement—the entrance for the air to be in a safe place, for coal-dust tends to fall upon the light with the intake. An intake similar to the "Marsaut" would make this an ideal safety lamp. Another considered drawback is that the lamp is extremely liable to go out when toppled over, but all keen observers of the safety lamp will agree with me in considering this an advantage rather than a drawback.

### Blasting.

Blasting coal is prohibited at the colliery, but in such places as can be blasted with safety, explosives are used for blasting down stone. The explosive used is Gelignite in conjunction with the water cartridge, being exploded with an electric battery and fulminate of mercury detonating cap.

Gelignite is a nitro-glycerine compound, or a mixture of two other mixtures. The makers declare the explosive to be made up of 65 parts of a mixture composed of 94 parts of nitro-glycerine and 6 parts of nitrated or gun-cotton, and 35 parts of a mixture composed of 80 parts of nitrate of potassium and 20 parts of wood meal. The explosive much resembles soft soap in colour, but is of a more coherent consistency.

(*To be continued.*)

# CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.

Envelopes to be marked "Correspondence."

Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

Correspondence must not be enclosed with Competition Answers.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### Competition Questions.

Sir,—Having read the alterations you have made in your Mining Journal, I think it is a step in the right direction, and one worthy of congratulation in allowing your mining students nearly a week longer in answering your competition questions, which I think was rather too short a time for to answer them; and I, for one, think that your numerous subscribers will be greatly benefited by the change. I see sometimes in your competition questions the names of persons who take the prize in the elementary stage who also take prizes in other mining journals in the advanced stage. This I think is very unjust of the persons who do it, as it does not give us poor colliers and trammers a fair and equal chance to compete, and in the end, many an aspiring student is discouraged. This matter is one that cannot justly be remedied by you, but I hope you will allow me to make a suggestion, which I think is a fair one. Say if a student in any of the stages continues to answer the questions for a period of two years, and obtain, I will say, $\frac{3}{4}$ths the amount of prizes out of $\frac{4}{5}$ths, I think he ought to take a higher stage. No student to stop answering questions whereby he may remain in the same stage, or unless he does not answer in any particular stage for a period of six months. After a period of six months he may answer questions in any stage until he has answered $\frac{4}{5}$ths of the questions. The Editor to take the number of questions answered and record them every two years, at which time any student who has answered $\frac{4}{5}$ths of the questions will know that he has to take a higher stage. The Editor to publish the names of the successful students in the Mining Journal. Please insert this for suggestions from your numerous readers. John Hy. Senior.

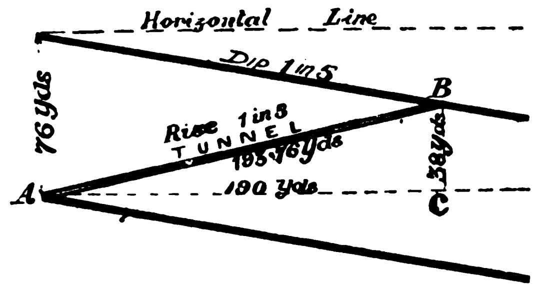
### Mining Problem.

Sir,—I think Mr. D. Spence's solution in No. 18, Vol. II., to the following question is incorrect:—

There are two mines dipping 1 in 5, and they are 76 yards apart, a tunnel rising 1 in 5. What is the length of the tunnel?

He says there are two possible solutions, in one of which he takes the tunnel as rising 1 in 5 from the lower seam and thus brings it horizontal. To be horizontal and rising 1 in 5 at the same time is absurd.

In the second solution he takes the correct view of the question, but falls into a common mistake. The tunnel rises 1 in 5, and as the top mine dips 1 in 5, the tunnel gains 2 yards in 5—*horizontal*. It will therefore find the top seam in a distance of $\frac{76 \times 5}{2} = 190$ yards—*horizontal*. This is where Mr. Spence makes a mistake, he assumes 1 in 5 to mean for every 5 yards along the tunnel it rises 1, in which




case the tunnel would be 190 yards long. But the correct meaning is for every 5 yards horizontal the tunnel rises 1 yard. Now as the tunnel has to go 190 yards horizontal distance to find the other seam, and as it rises 1 in 5 in this distance, it will have risen a vertical distance of $\frac{190}{5} = 38$ yards. The question is now resolved into finding the 3rd side of the right angle triangle ABC. The square of AB equals the the squares of AC and CB; therefore $AB = \sqrt{190^2 \times 38^2} = 193{\cdot}76$ yards = length of tunnel. "Mining Student."

### Air Currents.

Sir,—May I ask some of your numerous readers to favour me with their experience in testing "Air Currents" in underground airways. Have they tested the same air current with both anemometer and powder and compared the results, if so, I should like to know their findings, and how near a careful powder test comes to the test by anemometer. David Lawn.

# ANSWERS TO QUESTIONS

## In No. 18, Vol. 2.

### ELEMENTARY.

*Question* 1.—Describe briefly how coal or mineral is brought from the face to the shaft bottom.

*Answer.*—In bringing coal from the face to the shaft the first stage is generally performed by drawers or ponies. The distance which the drawers take the tubs is about 100 yards, to the shunt. From the shunt or siding the tubs may be taken in sets of from ten to twenty by the horses, direct to the shaft if the distance is short, or to the main engine plane. If the coal is worked on the rise, the descent of the full tubs may be employed to haul up the empty tubs by means of a self-acting incline, which is the most economical method of haulage possible. When the haulage road dips from the shaft sufficiently to allow the empty tubs to run down and drag a rope after them the main-rope system of haulage is employed, an engine being used to haul up the full tubs, which are worked in sets of from six to forty tubs, according to the output. If, however, this method cannot be adopted, then the main-and-tail rope or the endless system is employed. In the main-and-tail rope

method two ropes are necessary, each having a separate drum. One rope is used to haul out the full tubs, as in the main-rope system, and the other—the tail-rope—passes along the side of the road on pullies, round a return sheave at the in-bye end, and is attached to the back end of the tubs. The main-rope hauls the full tubs out, and the tail-rope drum being loose the tail-rope is also pulled towards the shaft. The empty tubs are then pulled in by the tail-rope, and the main-rope being attached to the other end of tubs is also drawn in-bye ready for another train of full tubs. In the endless system two sets of rails are required, one for the full tubs and the other for empties. The rope passes from the engine pulley along one side of the road, passes round a sheave in-bye, and returns round the other side to the engine pulley again, forming an endless band which always moves in the same direction, and thus hauls the full tubs up one road and takes the empties in the other. The endless chain is arranged similarly.—
HENRY TALBOT.

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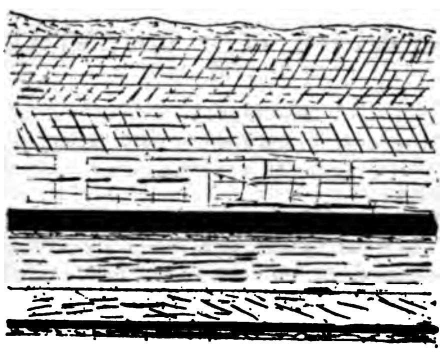
*Question* 2.—What is coal, and how is it found? Give sketch.



**Sketch shewing how Coal is found in Stratified Deposits.**

*Answer.*—Coal is mineralized vegetable matter. Though it may seem strange it is still true that coal is the remains of the vegetation which once grew on this surface many centuries ago, but which has been buried deep beneath the earth's surface. When we go down in a mine we can see the roof, floor and passages covered with impressions of leaves, ferns, and other plants. If we slice a piece of coal very thin we see in the coal itself the traces of vegetable matter. Coals differ very much in their composition so far as the proportions of their constituents are concerned, but the essential elements are the same in all cases, namely: carbon, hydrogen, and small quantities of nitrogen and oxygen, sulphur, silica, lime, and alumina.

The constituents of coal, according to their value in fuel, may be classified under three heads, viz.:—(1) Carbon and hydrogen which supply the heat and light. (2) The constituents which reduce the value of coal, such as sulphur and nitrogen. (3) The worthless constituents, such as silica, oxides of iron, magnesia, lime and alumina; all the latter constitute the ash.

The vegetation which once grew on the surface being gradually decomposed by the action of time, we have got the vegetation in form of the mineral coal. We can, to a great extent, follow this action. We have wood, peat, lignite, earthy coal, cannel coal, bituminous coal, and anthracite coal.

Coal is found in regular layers or beds, sometimes inclined and sometimes nearly vertical. The earth's crust has at certain times been subject to upheavals and sinkings. In many cases, the rocks forming the earth's crust have had a tendency to break rather than bend, causing dislocations and interruptions of the strata. These dislocations may be either rents or cracks, without any vertical displacement or faults, that is, where the rocks have not only been rent but where one side has either been pushed up or down, thus causing the coal seam to be found at either a higher or a lower level. These faults cause serious difficulties in mining operations.—
JOHN HY. SENIOR.

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*Question* 3.—What is fire-damp, and how is it dangerous in mines?

*Answer.*—Fire-damp is known by other names, such as light carburetted hydrogen, marsh gas, and methyl hydride. Its chemical symbol is $CH^4$ indicating that it consists of one part of carbon to four parts of hydrogen. The proper composition of fire-damp is 75% carbon and 25% hydrogen, thus equals 100%. Its specific gravity is ·555. Firedamp being composed of carbon and hydrogen, and the fact of its being produced by decaying vegetation, perhaps explains the great blowers or accumulations of it pent up under pressure in the crevices amongst the coal strata. Fire-damp is much lighter than air, and rapidly diffuses itself through the air of a mine with which it forms a highly explosive mixture. 1,000 cubic feet of air weigh 80¾ pounds nearly, while, under the same conditions,

1,000 cubic feet of fire-damp only weigh about 45¼ pounds. Thus we see fire-damp is much lighter than air, and we may nearly always expect to find it next to the roof or in the higher or rise points of the workings of a mine. This gas oozes out of the coal itself, and also from the cracks and fissures of the roof. It is also given out from between the cleats of the coal seam and in the neighbourhood of faults and dykes. More of this gas is given out in deep mines than shallow ones. When 1% of this gas is mixed with 30% of air its presence can be detected by the blue cap surmounting the flame of a safety lamp. When a mixture of 1% of $CH^4$ and 15% of air is ignited the result is a violent explosion. When 1% of this gas is mixed with 9·4% of air it is then at its most violent explosive force. When 1% of this gas is mixed with 5% of air it no longer becomes explosive but extinguishes the light of a lamp. Pure fire-damp burns with a pale lavender flame, the products of combustion being carbonic acid and water.

Like all other gases fire-damp is subject to Boyle's law, and in the event of a reduced atmospheric pressure shewn by the barometer this gas is given off in considerable quantities from the goafs and cracks in the roof and floor of coal seams. At this time the deputy should be very cautious in his inspection of the working places. Its presence may be detected at any place by the effect it has on a safety lamp. If it be present in small quantities it causes the flame of a safety lamp to flicker vertically. When a larger quantity is present it can be detected by the blue cap. When fire-damp is mixed with CO the blue cap is tinged with brown, and the flame is thickened and elongated a little more than usual. To detect small quantities of this gas or the blue cap requires great skill as it is a very delicate test.—

John Hy. Senior.

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### ADVANCED.

*Question* 4.—What is the construction of safety fuse, and how is it worked?

*Answer.*—Fuses are of various descriptions and various makes, but the one for *ordinary* work is a small thread of powder inside a case or coat of cotton or rope-yarn, and then covered by a coat of gutta-percha. It is then varnished to protect the gutta-percha from the effect of the atmosphere. This class of fuse blasts very well in water, but another class can be got with an extra coating of tape and composition varnish, which not only protects the gutta-percha from oxidation but retains its strength for a much longer time. The diameter at finished size being ¼ to 5/16 inches, and 5/16 to ⅜ inches. There is also the metallic fuse in which the core is covered with lead pipe, but this is not much used as it is brittle and very easily damaged. Ordinary fuses are sold in coils 24 feet long, and burn at the rate of two feet per minute.

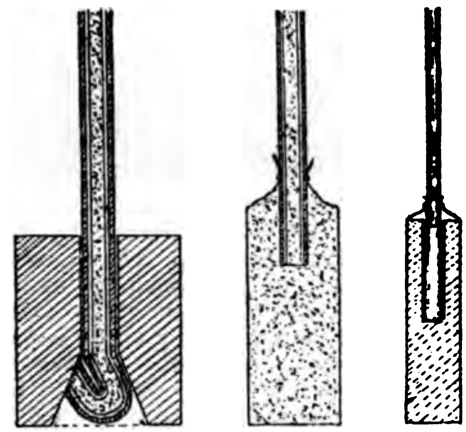

Fig. 1 Fig. 2. Fig. 3.

How to Use.—Under the Mines Regulation Act powder can only be taken into the mine in cartridges. If it is compressed powder there is a hole through the centre, conical at the bottom, and the fuse is put in as fig. 1; but if it is a loose-powder cartridge it is put in as fig. 2, and pushed gently to back or bottom of the hole and then tamped with a copper or composition of copper tamping rod.

With detonating explosives a piece of safety fuse is cut clean across and inserted in a cap or detonator—this is a small copper cylinder charged with fulminate of mercury, a very high explosive—and a pair of nippers is taken and the capsul is squeezed closely around the fuse. It is then inserted into the dynamite or gelatine cartridge and tied tight (fig. 3), and given a coat of tallow or grease to protect it from damp or water, and is ready to insert into the hole, and if the blasting is to be done in water, or water tamping is used, it must be made water-tight around the detonator, and well greased as aforesaid.—

Thos. E. Aitchison.

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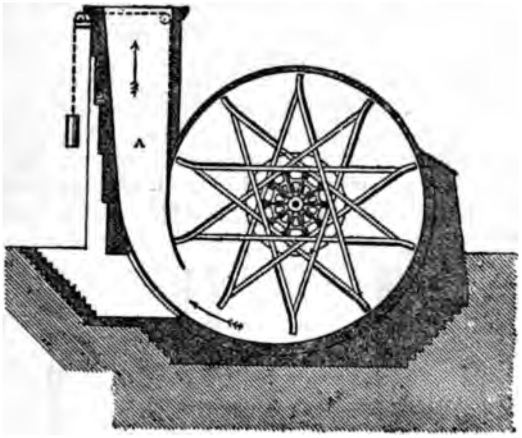
*Question* 5.—Describe, with sketch, what you consider to be one of the very best fans in use at the present time.




*Answer.*—The "Guibal" fan I think is still the best although it is not perfect any more than any of the other fans. The "Guibal" fan is the class of fan principally used in Scotland, and is made from 12 to 40 feet diameter, but the size mostly in use is about 25 feet diameter. The blades or vanes are from 5 feet by 7 feet to 10 feet by 8 feet, and for the larger class of course the vanes are proportionately larger. These vanes are made of lining five-eighths of an inch thick, and bolted on to angle iron arms secured to cast-iron boss, and these two bosses are keyed to a crank shaft, and driven by a direct-acting engine. The fan is entirely closed in with brick-work or casing, and the air is discharged into a chimney. I have seen this class of fan 25 feet diameter, 10-feet by 8-feet vanes driven at 90 revolutions per minute, but from 60 to 75 is very common, a great many are driven far less, and the fan gives the best results with a sliding shutter.—THOS. E. AITCHISON.

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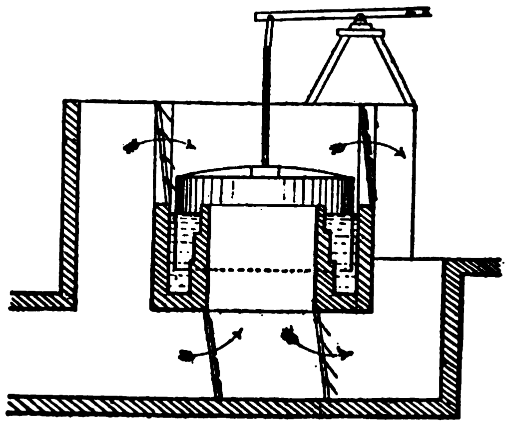
*Question* 6.—Describe, with suitable sketch, the STRUVI ventilator, and discuss its efficiency.

*Answer.*—The "Struvi" ventilator is an air pump or air compressor, with this difference that it draws the air from the mine and discharges into the open, and is upon a large scale. It is adopted at several collieries, especially in Belgium, and generally has pistons working in cylinders of from 6 feet to 22 feet diameter, placed vertically. The valves have had to be complicated from being very numerous, and from being fitted with counter-balances, attached by light levers, in order to diminish the resistance. A great diminution in friction has been obtained by making the piston in the form of a gasometer plunging with its sides in a ring of water. This latter plan has been carried out on the largest scale in Mr. STRUVI's ventilator, now working at some collieries in South Wales. His piston is a close-topped wrought-iron bell of from 6 to 22 feet diameter worked up and down in water, and by means of ranges of valves above and below, placed in the walls of the piston-chamber it draws in and forces out air at each up and down stroke. The action will readily be seen from the sketch. These machines are usually composed of two such pumps worked by a steam engine, and it is said, capable of giving a theoretical amount of 20,000 to 100,000 cubic feet of air per minute, and costing about £200 per calculated 10,000 cubic feet.


The Struvi Ventilator.

The efficiency of this pump or ventilator would do well to ventilate a ship, hotel, or small mine, but it would not do for a large colliery, and I think that the fan far supersedes it in every respect—(1st) This ventilator would be more expensive at first cost and would not give such good results as a fan. (2nd) A great deal of power is lost in the opening and shutting of the valves. (3rd) The fan can draw from large sectional area, whereas this pump has its area cut up into net-work by the valve frames or stops (flap valves 24in. × 16in.) and therefore causes more resistance to the air. (4th) In the case of emergency, it might have to be driven so fast that the pressure would be so great as to force the water packing out of the ring and leave the pump worse than useless. (5th) The ventilator is liable to get out of order by reason of its numerous valves.—

THOS. E. AITCHISON.

FIRST-CLASS.

*Question* 7.—Do equal quantities of air go to the dip and rise workings under similar circumstances?

*Answer.*—Equal quantities of air do not go to the dip and rise working under similar circumstances, because should the air just be leaving the downcast and split to the dip and rise workings, the greatest quantity will go to the dip under the same conditions, as it is then heavy and has a natural tendency to descend.

To obtain the best effect from these circumstances the principle is generally carried out in the form of ascensional ventilation where the seam is inclined, by taking the intake current at once to the lowest level in the mine, and thence leading it through the workings in an ascending direction, because the intake air is always cooler than the return, and its temperature is gradually raised as it passes through the workings, and by making the current to coincide with the natural tendency to ascend, it is assisted by the latter, whilst in the reversed direction it would be opposed by it.—JOHN MCPHAIL.

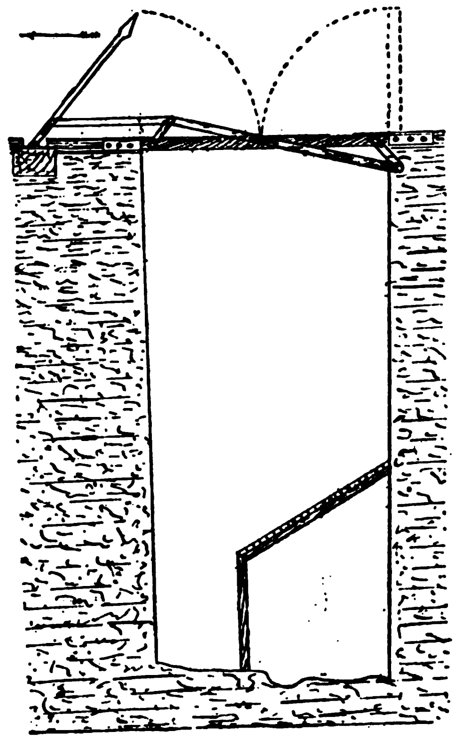
*Question* 8.—How would you take an accumulation of gas out of a "hole in the roof," the "face of brushing," a "longwall cundie," and edge of the waste at a lift or stooping?

*Answer.*—I would take an accumulation of gas out of a hole in the roof by erecting a hurdle or dash screen, *i.e.*, a screen fixed under the centre of the hole but not up to the roof, so as to throw the air up into the hole and remove the gas over the top.

In removing the gas from the face of the brushing I would fix a screen across the roadway or drift as near the face of brushing as possible, then I would carry a temporary brattice of cloth out to the head of brushing; then the air that was travelling up the face would have to pass out on one side, and by the force of it coming through the contracted area and striking the screen, which would throw it up and wash out, or force the gas along the other side of the brattice. In such cases, safety lamps would have to be used, and if a dangerous accumulation was present the workmen would have to be removed from the circuit that the air and gas had to travel. If gas should accumulate in a longwall cundie, the velocity of the air-current would have to be increased, or else the air is scaling or escaping somewhere, which may be remedied by packing the sides of screens and doors so as to make them air-tight, but a little air is generally allowed to scale through the gateways to keep them clear; therefore the screens should be set in the latter as near the face as possible, so as to send the full force of the air-current into the cundie and remove the gas.

Gas at the edge of the waste at a lift or stooping is a frequent occurrence, and a good brisk current of air should be kept circulating along the rances, and the only method of removing such gas is to allow the force of the current to act on it by drawing a brattice across from the face to the waste, so as to allow the force of such current to clear it out.—JOHN MCPHAIL.

*Question* 9.—Describe with suitable sketch how sinkers are protected from material falling down the shaft.



*Answer.*—The greatest danger from material falling down the shaft arises from an imperfect method of landing the kettle when it reaches the surface; the old method of pulling it out by the hand, or swinging it out by a chain

attached to the head-gear being apt to throw some of the contents back down the shaft if strict precautions are not adhered to, and wherever such is adopted, a penthouse should be erected in the bottom of the shaft, as shown by the accompanying figure, which consists of a temporary sloping roof of boards, supported on legs fixed in the shaft, so as to cover the part where the sinkers are at work, and guide any falling material off them. The best plan however is to have the top of the shaft covered by a pair of folding doors, which opens by means of drawing the handle assisted by a weight hung at the end of a fixed lever, so that the pair of cranks fixed rigidly to the doors and connected by a connecting rod are opened in opposite directions, thus turning up each door to the opposite side of the shaft. (See top of accompanying figure). These doors are opened to let out the ascending kettle, and then allowed to fall back by their own weight; the tram road which extends from the top to the edge of the pit is continued on the top of these doors by fixing rails on the back of each, and when the door falls, a tub of special make for easy tipping, kept ready, is run on to the doors under the kettle, which is immediately lowered and upset. The tub is then withdrawn, the trap doors opened as before, and the kettle descends. All this is effected in a very brief space of time and without the least difficulty or danger. Prevention may also be effected by keeping the sides secure without delay, and using a double engine with flat ropes for steadiness to the kettle; then with the assistance of a careful banksman, nothing serious should result.—JOHN MCPHAIL.

*Question* 10.—Two exhaust fans are placed in connection with an up-cast shaft; each fan is 20 feet diameter and 6 feet wide; one standing, and the other going at 60 revolutions per minute produces 80,000 cubic feet of air, with 1 inch of w.g. Find the quantity and w.g. of the following:—(*a*) one going at 80 revolutions per minute and the other standing. (*b*) Both connected to the up-cast, and going at 60 revolutions per minute. (*c*) One exhausting through the other.

*Answer.*—(*a*) The quantity increases directly as the speed of the fan. Thus, $\frac{80,000 \times 80}{60}$ = 106,666·66 cubic feet.

The water gauge increases directly as the *square of the speed* of the fan. Thus, $\frac{80 \times 80 \times 1}{60 \times 60}$ *= 1⅞ inches water gauge.*

(*b*) As the quantities of air vary as the cube roots of the powers employed, then as both fans are alike the power will be doubled, and the quantity will be increased from 1 to the cube root of $\frac{\sqrt[3]{2}}{\sqrt[3]{1}} \times 80,000 = 100,720$, or an increase of 20,720 cubic feet. Then if with 1 inch of water gauge 80,000 cubic feet of air was produced, the height of water gauge for 100,720 cubic feet will be in the same proportion, or as $\frac{100720^2 \times 1}{80,000^2} = 1{\cdot}58$ inches water gauge.

(*c*) The quantity is the same as *b* less the amount required to overcome the extra friction of one exhausting through the other.—JOHN MCPHAIL.

## AWARDS

FOR ANSWERS TO QUESTIONS IN THIS ISSUE.

ELEMENTARY.—J. H. Senior, 16, Thompson Row, High Street, Rawmarsh.

*Commended.*—H. Talbot, H. Hall, D. W. Irvine, J. Stephenson, W. T. Hewitt, J. King, J. H. Berry. J. T. Ward, J. F. Cox, G. Deverill.

ADVANCED.—T. E. Aitchison, Green Hill, Dunaskin, Ayr.

*Commended.*—S. Davies, W. Durney, J. Jackson, G. Daykin.

FIRST-CLASS.—J. McPhail, 6, Sourlie, Irvine, Ayr.

COMPETITION QUESTIONS.

*Note.*—We are sorry that the Advanced students have not sufficient ambition and integrity to keep to the higher stages of the Competition Questions, but it is nevertheless true that some of the students who should answer the First-Class Questions compete in the lower stages. In our opinion students who have obtained a certificate in the Elementary Stage of the Science and Art Department or similar Examinations should compete in the Advanced Stage of the Competition Questions, and those who have passed in an Advanced Stage should devote themselves to the First-Class Questions. We do not wish to lay down a hard and fast rule in this matter, as the questions in one stage may not be always suitable to a student, but we wish competitors would try to effect a compromise so as to facilitate matters for junior students.—THE EDITOR.

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—Technical World, Invention, Universal Index, Miner, T. Makinson.

A PRACTICAL MAN.—We will publish your article on Steam Boiler Explosions.

G. SINCLAIR.—See letter and Editor's note in present issue *re* Competition Questions.

MINING FORMULÆ.—So much mining formulæ has been published that it is a difficult subject to form original matter on; if you will however forward your manuscript we will see if it is suitable for our pages.

*Printed and Published by* STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MINI

o 22. Vol. II. SATURDAY, SEPTEMBER 22, 1894. FORTNIGHTLY. ONE PENNY.


## CONTENTS



## EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in No. 2, Volume II.*

#### TO MAKE A SURVEY WITH THE MAGNETIC NEEDLE.

TO make a survey underground it is necessary to have some fixed station to commence from or finish at, which is shewn on the plan on which the survey is to be plotted. The usual procedure is to have two such stations, one to commence the survey from and the other to finish at, in order that, when the survey is plotted, it will be apparent whether it is correct or not.

All mines are now provided with two shafts, a downcast and an upcast, and these are included in the surface survey and plotted on the plan. If the shafts are perpendicular, which is usually the case with coal mining shafts, we have at once two points on the plan which correspond with two stations underground, and from these stations the survey commences. As the mine becomes extensively worked it would be impracticable to survey from the shaft every time, so stations or "dial marks" are left every survey for the succeeding one. The station is left on one of the sights of the survey, and a note is put in the book that a mark has been left at this point. The station is denoted underground by putting a ring of whitewash or paint round the spot, if it is a mine with a good dry roof, or by driving a wooden plug 4 inches diameter in the floor or roof, which ever is found the better.

As an example of how a mine is surveyed take the longwall workings shewn by Fig. 72. The survey would commence at one of the shafts, say, the downcast, and proceed round the workings, and, if possible, tie in at the upcast. The measuring assistant holds a light at the centre of the downcast shaft, and the surveyor proceeds towards A as far as he can conveniently see the light. Assuming that the road is perfectly straight, and that a light held in the centre of the shaft can be seen at A, the surveyor plants the legs of the dial at this point, having previously seen that the iron, if any, has been removed from the locality. The legs of the dial should be so placed that a sight may be also taken along the road to B without having to remove them. The dial is then placed on the legs, the levelling adjustment made, the needle allowed to swing freely, and the sight taken to the light held at the shaft. The north end of the dial should always be in the direction in which the survey is proceeding, so that in this case the survey would look through the north end, and adjust the dial until the vertical hair of the south vane covers the sight object. The dial is then clamped on the legs, and the needle having settled the bearing is read off. In the meantime an assistant has proceeded towards B, and as the road is straight a sight can be taken to this point. The dial is unclamped but not removed, and with its north vane towards B the bearing is taken. The length from the

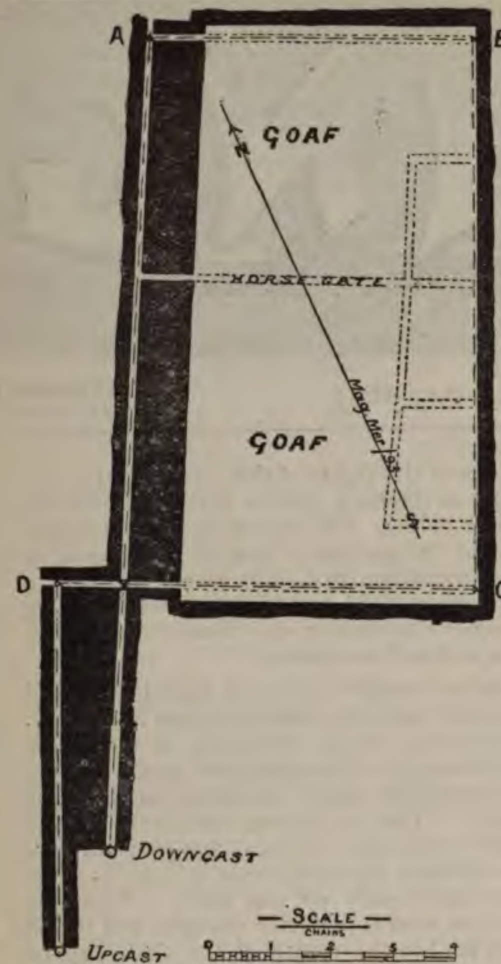
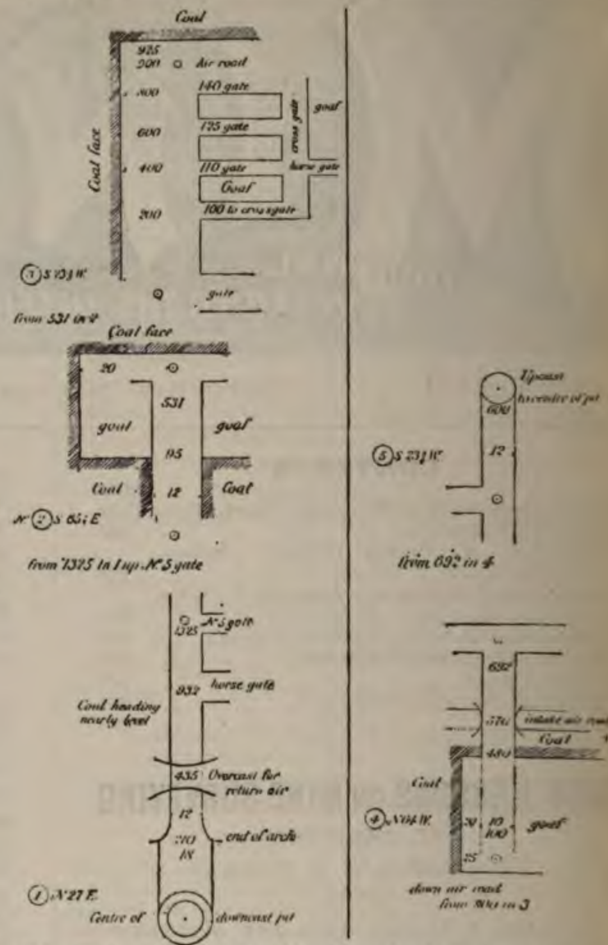



Fig. 72.




*N.B.—The lengths are in links and have been reduced to horizontal lengths.*

Fig. 73.

shaft to A is next measured, the width of the road, the branch gates, and any other point of importance being read off during the measuring. The same is done with the road to B, care being taken to read off the point where the longwall workings begin. The lengths being recorded in the book, the surveyor proceeds with the dial towards C, and the dial is set up at this point. A sight is then taken back to B and a forward sight to D, and the measurements taken as before. Now as the return airway from D to the upcast shaft is straight, only one more bearing is required, in which case the dial may be set at D immediately under the mark at which the sight lamp was held, the position being accurately found by means of a plumb-bob and a sight taken to the shaft; or the dial may be set up midway between D and the shaft, and a backward and forward sight taken as before. The backward and forward sights should coincide with each other or nearly so, as the road is straight, and one measurement could be taken from D to the upcast. If the two bearings were different, however, a measurement should be taken from D to the dial, and another measurement from the dial to the shaft. The position of the gates and cross-gate may be fixed with sufficient accuracy, by measuring down each gate to the centre of the cross-gate. It might be found expedient to leave station marks at B and C from which to commence subsequent surveys, to avoid the necessity of surveying from the shafts.

### The Survey Book.

There are two distinct methods adopted of booking underground surveys, one in which a rough sketch of the workings is made as

the survey proceeds, the bearings and measurement being placed in their correct position with reference to the sketch, the other in which each bearing is taken as a separate line and the survey is booked like a surface survey. Perhaps the former method is the simpler and quicker, besides which the approximate position of the workings is known to the surveyor whilst making the survey, and this enables him to proceed with his work with greater facility. The second method however recommends itself to certain circumstances. If the roadways are of irregular width, or necessitate numerous side measurements or notes, then this method is the better as the small space allowed by the sketch does not permit of numerous notes being made. The size of the sketch is of necessity small to occupy only one or two pages of the survey book, whereas in the other case any number of pages may be used.

The bookings * of the longwall workings (Fig. 72), by the second method are shewn by Fig. 73. Here it will be seen that each bearing is numbered as a separate line, and reference is made at the bottom of every line to denote from what point the bearing is taken.

The booking of a portion of some pillar and stall workings by the first method is shewn by Fig. 74. The bearings are written

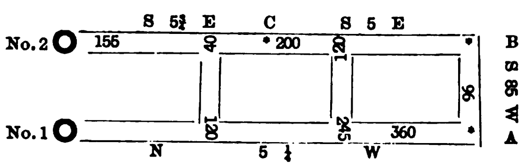



Fig. 74.

on the side of the road, and the measurements are placed between the two lines representing the road. A star or some such similar mark is placed at the end of each bearing, and to distinguish the full length measurements of the bearings from the intermediate lengths, they are booked parallel to the road or a ring is drawn round them, while the intermediate lengths are booked across.

* Taken from City and Guilds of London Examination Questions on Surveying.

(*To be continued.*)

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

## COMPETITION QUESTIONS.

To the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best answer to each question will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."

2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3.—Correct name and postal address must be sent.

4.—They must reach us by October 5th, 1894.

5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question* 1.—What is atmospheric air. Is there any variation of this air. If so, how does it affect the ventilation of mines?

*Question* 2.—Describe with sketches how you would secure the main haulage roads near the shaft of a mine whose output is expected to be large?

*Question* 3.—Name the two gases generally met with in coal mining, and state how they are detected and the results of their presence in the workings?

### ADVANCED.

*Question* 4.—How should a down brow place giving off black-damp freely, be ventilated?

*Question* 5.—Describe briefly with sketch map the South Staffordshire Coalfield?

*Question* 6.—Mention some of the best explosives now in use in mines and give the composition of a few of them?

### FIRST-CLASS.

*Question* 7.—Describe with sketch the travelling jiddy used for landing the hoppit in sinking pits?

*Question* 8.—In wide work with packing, if the dip is steep, how would you ensure air being kept up to the face?

*Question* 9.—Describe with sketch the bricking scaffold you would use in a sinking pit 16 feet diameter. State how you would support it when in use, and how you would raise and lower it?

*Question* 10.—If you had two coals, the top one 9 inches thick, and the bottom 5 feet 6 inches with 8 inches parting between, and a soft friable roof, how would you proceed to work them and how would you proceed to open such seam?

*(Answers to above will appear in No. 25.)*

# MURTON COLLIERY, DURHAM,

BY G. A. HAWES.

(With Illustrations.)

*Specially prepared for "MINING."*

(Continued from last Issue.)

## COAL SCREENING AND WASHING ARRANGEMENTS.

THREE separate ranges of screens are needed—one for the coals drawn from the main coal seam, one for the coals from the low main and the faulted portion of the Hutton seam, and the other range for the Hutton seam. The old-fashioned system of discharging the contents of a tub upon the inclined plane of permanent screen-bars is in vogue at the main coal and low main screens. A more novel and economic method of screening is in use at the Hutton seam, patented by the chief engineer and agent of the company. A tub is run into a tippler

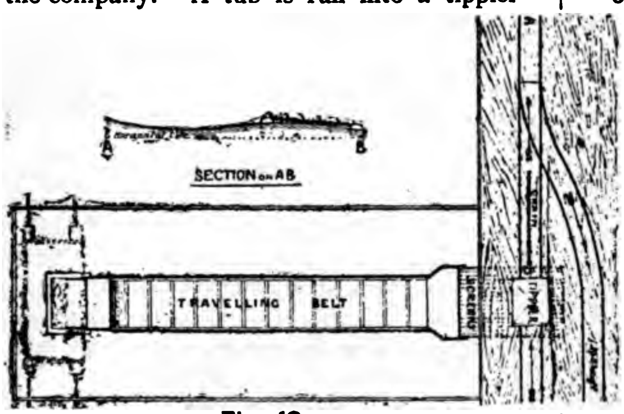



Fig. 10.

worked by friction rollers and turning inwardly, that is, turning to the slope of the screen; the coals are discharged gently upon a jigging screen, which is carried over the end of a large coal-cleaning belt, and as it works with a to and fro motion it deposits the coals upon the belt. The belt is worked round octagonal rollers at each end on the endless chain principle, the belt being constructed of steel plates, the length of each plate corresponding with the sides of the octagonal drum. The end of the belt is lowered when an empty wagon is put in, thus reducing the breakage of round coal to a minimum. Owing to the coals being exceedingly dusty a steam jet is placed at the point of discharge which immediately lays all the dust.

Boys are stationed along the elongation of the belt who pick out the most minute piece of inferior coal, shale, or pyrite; when anything unusual occurs as an overplus of inferior coal or the removal of the wagon at the belt-end when full, the belt can be immediately stopped by pressing an electric spring-push, which communicates to the man in charge of the engine. The whole concern is covered with bevelled zinc and lighted by a number of small incandescent electric lamps.

The arrangements for the discharging of the mineral at the tippler are excellent and are worthy of mention. A man is stationed at the tippler who actuates the lever controlling it, and when one tub has discharged its contents another is run in which removes the empty one to a small inclined railway; under this railway is travelling a heavy creeper chain provided with catches at intervals, these catches hold the axle of the tub-wheel and carry it up the inclined railway; at the top of the inclined plane another plane is encountered down which the tubs run by gravitation, the momentum thus acquired carries it up another small incline at the bottom of which is placed a pair of automatic switches, the tub runs back down the incline again and encounters the switches, which switch it to the empty way. The system might appropriately be called the "switchback principle."

The classifying of the small coals is effected by means of a chain of buckets which carry the small coals to a high elevation, to be classified into four classes: treble nuts, nuts, peas and slack, by a series of riddle screens.

## COAL WASHING.

Owing to the colliery having a large number of coke ovens, a good coal washer is an essential feature. An elaborate one has just been erected to succeed the Robinson Rotary Washer, which was burnt down during the Durham County Strike. The patentees of the new washer are Messrs. Wood and Burnett, the agent and engineer of the company; it consists of a highly modified type of Ramsey's old trough washer. The coal to be washed is conveyed to a high elevation by means of a chain of buckets into a hopper; the coal is discharged into a trough or what would be more applicable a travelling belt with raised sides; this travelling belt is composed of steel plates thoroughly water-

tight and jointed in a most ingenious manner, forming at each joint an overlap, thus making the necessary dam or cavity for the heavy inferior material to fall into. The belt is worked on the endless chain system, rotating round octagonal drums or rollers at each extreme end, each side of the octagon being of the same size as the steel plates forming the belt. The belt is 60 feet long by 3 feet

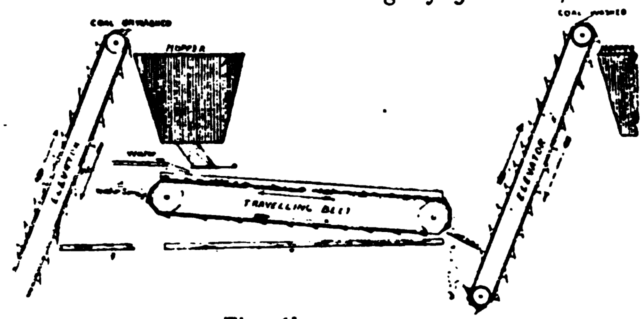


Fig. 11.

wide, and set at an inclination of 1¾ inches per yard; it works at the rate of 9 feet per minute, and is made to travel in a contrary direction to the current of water by which the coals are washed. The coal to be treated is delivered upon the belt at a point of 10 feet from the higher end and with it the requisite quantity of water for washing. Men agitate the water with rakes, the heavy inferior particles owing to their larger specific gravity, sink towards the bottom of the belt where they are caught in the cavities made by the overlap of the belt plate joints. When it comes to the octagonal roller at the higher end of the belt it discharges the inferior contents into a refuse hopper; at this point the belt plates are washed by a spray of water so as to prevent any inferior particle that may be adhering from mixing with the washed coal; the washed coal makes its way in an opposite direction, being carried in suspension by the current of water and discharged on to a perforated plate and ultimately into a coal hopper, where it is raised by a chain of buckets to an elevation above the coke-ovens. The advantage of this washer over the old form of trough-washer, is that no time is wasted in the removal of the inferior debris, the belt discharging it at its turn automatically. The washer is capable of thoroughly cleaning 400 tons of coal per day from all suphur and inferior material and at a very economic expense. The whole apparatus, including two chains of buckets and two travelling belts, is worked by a horizontal engine on a countershaft motion.

(*Concluded.*)

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

JOSEPH CARTER, First-Class Certificated Manager

WEST LANCASHIRE & NORTH WALES DIVISION (JUNE, 1893). COMMENCED IN No. 18.

### FIRST CLASS.

### Mine Working.—(Continued.)

QUESTION 17.—What precautions would you take to guard against underground fires in engine-houses? Suggest arrangements which would provide to minimise the danger which may result from an unforeseen fire in an underground engine-house.

ANSWER.—I would have the engine-house bricked and arched over. Pillars for engine also built of brick and embedded with stone for the engine seating, besides this, a distance away from the engine-house, on each side, bricked and arched, having as little timber about engine as possible. Have no naked lights about, but all locked safety lamps. Allow no accumulations of dirt, oily waste, &c., but keep the engine and engine-house perfectly clean and tidy. I would suggest the following to minimise the danger arising from such fires. All stations beyond the engine-house to have telephonic communication to each district, whereby instructions could be given directly the fire occurred to the person in charge of such district, and as electricity is now becoming largely used for signalling purposes in most of our modern mines it would not be much to adopt this method also. This would greatly facilitate the retreat of the men through the return to the upcast shaft, and it would enable the man in charge of each district to inform and gather his men together and pilot them through such roads before the fire could have gained any considerable hold. For the guidance of persons travelling such roads without a guide all such roads should have boards at intervals pointing clearly the way, so that in the event of a fire breaking out persons even in the absence of a guide could easily find their way.

QUESTION 18.—If you have 200 tons of coal a day to haul up a road 1,000 yards long, with an inclination of 1 in 5, where the tubs are put on at three different stations, describe what system you would adopt and what regulations you would enforce ?

ANSWER.—I would adopt the endless rope system. In this system two lines of rails are used, one for the empty tubs and the other for the full ones. Attached to the shaft of of the engine is a clip or flute-wheel, and at the other end of the plane a return wheel is fixed. Behind this is fitted the tightening screws, so that the rope can be tightened any time it may be required. A rope twice the length of the plane is required, and is endless, having the two ends of the rope spliced and adjusted accordingly. There are various arrangements used for clipping the rope. I would use the chain which is put a few times round the rope and hitched on. The tubs could be put on at each end of the stations either singly or in groups of 2, 3, 4, 5, or 6, according to circumstances, and as the rope moves slowly and constantly a continuous supply of boxes would be delivered at the pit shaft. I would have a separate and independent travelling road for persons to travel to and from their work. No person or persons to ride up or down the incline. Only allow those persons to travel who are authorised for the purpose of keeping the road in repair and for inspecting the same.

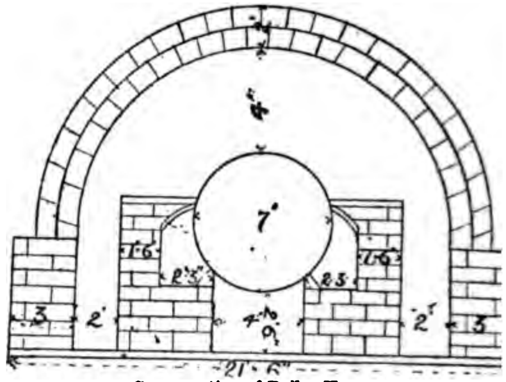
QUESTION 19.—Describe and sketch with dimensions, of a boiler-house and flues suitable for a boiler, 28 feet by 7 feet, to be placed in a mine 500 yards deep, and 30 yards distant from the upcast shaft.

ANSWER.—The following dimensions are what I should consider requisite for a boiler-house and flues, for a boiler 28 feet long and 7 feet diameter :—

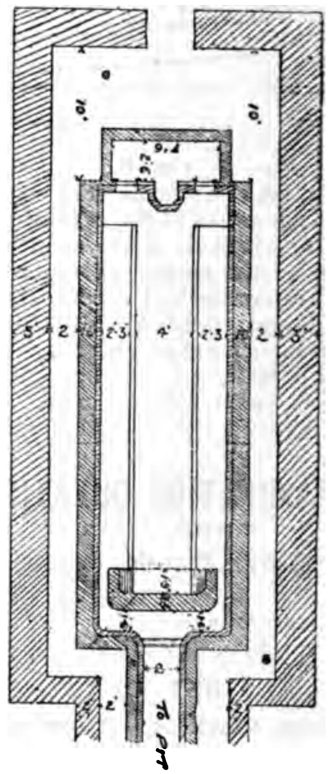
| | | | |
|---|---|---|---|
| Width of boiler-house | 15 feet | 6 inches. | |
| Height | ,, | 13 ,, | ,, |
| Length | ,, | 41 ,, | |

Outside walls 3 feet thick, with an open space on each side of boiler pillars of 2 feet, so that it can be easily examined on either side and along the outside of the flues when at work, and also leave room for repair without having to take a quantity of brickwork down to get at it.

The arch should be about 2 feet thick and 4 feet above the boiler, so as to allow space for the fittings of the boiler and access for examination. Such a boiler would require a storage for coal, which, included with the space occupied by the boiler, flues and foundations would require a length of about 47 feet.



Cross-section of Boiler House.



Ground Plan of Boiler House.

## Timbering.

QUESTION 20.—What are the requirement of the Mines Regulation Act as to the pro vision of timbering, and with regard to th duty of a collier as to its use ?

ANSWER.—General Rule 22 of the C.M.R.A says—That when the timbering of th workings is done by the workmen employed suitable timber shall be provided at th working place, gate-end or pass-bye, siding or other convenient place in the mine, an convenient to the workmen.

The duty of a collier (when timber is set by the collier) is to have a supply of suitable timber at his working face, and keep his timber well set at a suitable distance apart, say 3 or 4 feet at most, and nearer if required, and set them in a systematic order whether they are required or not. Sprags also should be set every 6 feet apart, and not exceed this distance but nearer if required. It is the duty of the collier to comply with this rule for his own safety, and many accidents which occur would be avoided if this rule was complied with.

QUESTION 21.—What is your opinion as to the use of iron and steel in place of timber in the laying out and working of coal mines?

ANSWER.—My opinion with regard to the use of iron and steel in place of timber, in laying out and working of coal mines, is that in main roads where it is likely to be in use for some years, if such roads were timbered and required renewing every two or three years, the adoption of iron and steel would no doubt be cheaper in the long run. In roads subject to heave or creep I should prefer timber, because when bars of iron become bent and require frequent changing, they are far more difficult to take out than timber bars, and the advantage of using timber in such cases is that you can saw it to the required length.

*(To be continued.)*

# CONVERSATION ON STEAM BOILER EXPLOSIONS

**By a PRACTICAL MAN.**

*(Specially prepared for "Mining.")*

QUESTION.—What are the causes of steam boiler explosions?

ANSWER.—Steam boilers usually explode from one cause—over-pressure of steam.

QUESTION.—What do you mean by the term over-pressure of steam?

ANSWER.—By saying that explosions occur through over-pressure, we do not merely allude to a pressure above the working pressure (that is, the pressure at which the safety valve allows the steam to escape), but more particularly to a higher pressure than that which the boiler, under *all circumstances* is able to withstand.

QUESTION.—What provision should be made in the construction of steam boilers?

ANSWER.—They should be constructed with a considerable amount of strength over and above that which is required to resist the ordinary pressure at which the boiler is to be worked. Boilers have often been made with scarcely strength enough to resist the working pressure, and the least accumulation of pressure above this is liable to endanger the boiler.

QUESTION.—But why have boilers been so constructed as not to be strong enough to resist the requisite pressure, and no margin of safety left?

ANSWER.—The above result has been traced, in some instances, to the ignorance of those persons who had the fixing of the working pressures, they not having understood its power of resistance, resulting from a particular shape or form.

QUESTION.—But have not boilers exploded which were originally made strong enough to resist a much greater pressure than that at which they were being worked?

ANSWER.—Yes, no doubt there have been such occurrences, and it is probable that the cause of the explosions might have been traced to negligence on the part of those persons who were responsible for the examination of the boiler. The strength of the boiler through considerable usage, may have been reduced to such an extent, as not to be sufficiently strong to sustain the working pressure, which might have been detected by proper inspection.

QUESTION.—What then should be done with a boiler whose strength has been so reduced?

ANSWER.—It should be put to lighter work and worked at such a pressure as to leave a large margin of safety.

QUESTION.—Are not boilers liable to explosion through having been altered from their original form?

ANSWER.—Yes, if proper precautions be not taken. Cases have been met with where the tubes have been taken out of Lancashire and Cornish boilers, thus converting them into plain cylindrical boilers with flat ends. The tubes have been so much worn as to be unfit for the purpose they were originally used for. It must be remembered that the internal tubes of both Lancashire and other boilers are efficient longitudinal stays, (that is, stays to prevent the boiler ends being blown out), and when the tubes have been removed

and no other contrivance for giving strength to the boiler ends substituted, it is not to be wondered at if an explosion is the result. It should also be remembered, that if a longitudinal stay got bent from any cause, its efficiency as a support is materially lowered.

QUESTION.—Are not boilers oftentimes endangered through unequal contraction?

ANSWER.—Yes, and this may occur from many causes; every time a gush of cold air finds its way to the plates, as for instance, when the door is opened or the damper raised too high, contraction to a certain extent is liable to occur. After a certain amount of contraction and expansion, the plates become more or less brittle according to the quality of the material of which they are constructed, and the result may be a fracture from the rivet holes to the edge of the plate.

QUESTION.—Do not explosions sometimes occur through a collapse of the boiler tubes?

ANSWER.—Yes, in March, 1838, and in June of the same year, an explosion occurred on board the "Victoria," from collapse of flues. In September, 1838, a similar explosion occurred at Newton and from the same cause.

QUESTION.—What are the probable causes of boiler flues collapsing?

ANSWER.—In the above cases, the flues were oval in section, which, of course is a weak form of boiler flue or tube.

QUESTION.—Which is the strongest form of boiler tubes to resist collapse?

ANSWER.—Cylindrical tubes are the strongest, either for internal or external pressures; it has been found by experiment, that with tubes having the same diameter and thickness of metal, the resistance to collapse is inversely as the length (nearly) and with tubes of the same length and thickness but of different diameters, the strength is inversely as the diameter.

QUESTION.—What is meant by the term "collapse"?

ANSWER.—By collapsing, we mean the crushing in of the tube through being pressed upon by the steam in the boiler. In the above experiments referred to however, respecting the resistance to collapse of boiler tubes, the term collapse simply implies a change of form from the circular or eliptical arched shape of the transverse section of the tubes, either by wrinkling or bending.

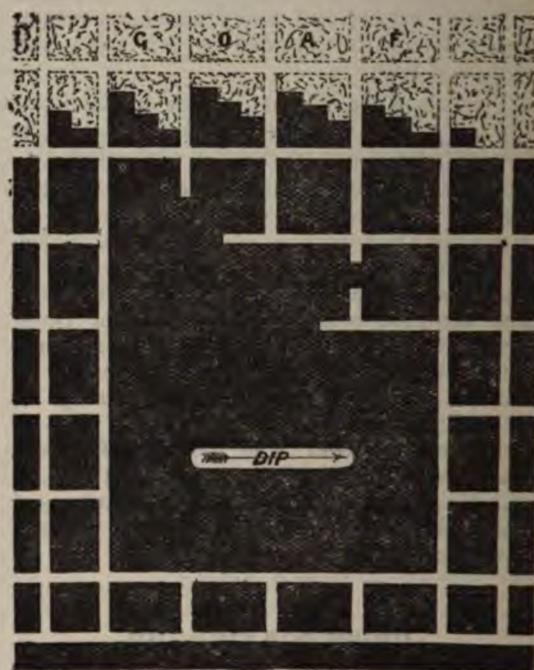
*(To be continued.)*

## ANSWERS TO QUESTIONS

In No. 19, Vol. II.

### ELEMENTARY.

*Question 1.*—Give an account of the pillar and stall method of working coal. What are the conditions in which this method would be adopted? Give sketch.




*Answer.*—After driving out the main roads, usually four in number, two intakes and two returns, the first procedure is to divide the coal into a series of rectangular blocks, by means of drivages, called "bords," "stalls," and "walls," the line of the latter being spoken of as headway's course. The bords or stalls are driven at right angles to the cleat of the coal, and are usually 4 to 5 yards wide. As a rule walls are driven 2 yards wide. The pillars are now made and their removal is commenced, while the driving of bords or stalls proceeds only a short distance away. In this manner the percentage of round coal is increased and the pillars are scarcely touched at all, which is especially noticeable where both roof and coal are tender.

LANCASHIRE METHOD.—A pair of roads are generally driven from the shaft to the dip, and out of these, levels 30 yards apart,

are driven direct to the boundary. Each pair of levels are 200 yards apart, and the coal is left solid between. On reaching the boundary two sets of levels are connected by a road, and the coal between is divided into pillars by means of drivages crossing each other at right angles. All the pillars are not cut off before commencing to remove the coal, but are gradually formed. The pillars are removed by lifts. These lifts are usually 12 to 15 yards wide, and are taken forward like a longwall face. A line of rails is carried by the side of the coal, and a pack wall built on the other side. Two rows of chocks are kept parallel with the face, and at the same time a third row is being withdrawn, props being set all round while such is being done. Where the coal is tender and the roof a good one, this gives a large percentage of round coal. Or sometimes where the roof is tender this system has found considerable favour. It is largely employed in seams of 6 feet and 7 feet thick in Lancashire. (See sketch.)

JAMES JACKSON.

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*Question 2.*—Describe the method of haulage you would adopt in a mine dipping 1 in 15 from the shaft.

*Answer.*—The method I should adopt would be endless rope haulage, providing the state of the roof was good. This system requires two lines of rails and a wide road, the rope passing over the tubs which may be run singly or in sets. The rope passes down the shaft from a pair of hauling engines to the pit bottom, it then passes over two pulleys down the down-brow right to the bottom, and then up again to the hauling engines, and it keeps travelling from the engines to the bottom of the down-brow. To the side of the rope that passes down the down-brow, empties are attached either with chains or clips, and the full tubs are connected in the same manner and pass up the side of rope going up brow to the shaft. Successful working is influenced by the arrangement to some extent for taking up slack rope, at the same time putting enough tension on the rope to prevent any slip on the driving pulley. Tension carriages should always be placed at the lowest end of the road, the full rope led on the driving pulley then to the tension pulley, and passing away as the empty rope. Naturally the pulling or full rope is always tight. The best plan is to carry them half round a pulley on a carriage, which can be either weighted and travel on an incline, or it may be on the flat with a weight attached behind a length of chain, this weight exercising a direct pull on the wagon. Where only one or two tubs are attached at a time, the delivery to the shaft bottom is a model of regularity, the tubs coming and going with scarcely any attention. At main stations, where branches are worked, the usual arrangement of switches and crossings is employed, and as the ropes are either above or beneath the road, no provision has to be made to prevent them being injured. An endless rope can be laid anywhere, although to obtain the best results the road should be laid out to suit it, the only objection against this system being that a double road is necessary.

JAMES JACKSON.

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*Question 3.*—What is the quantity and value of 70,430 square yards of coal, three feet two inches thick, at £80 per foot thick per Cheshire acre.

*Answer.*—

TO FIND THE WEIGHT.

Specific Gravity of coal = 1·26, or a cubic yard of coal = 19 cwt.

$70430 \times \frac{38}{36}$ = cubic yards of coal.

$$\frac{70430 \times 38 \times 19}{36 \times 20} = \underline{\underline{70625{\cdot}6 \text{ tons.}}}$$

TO FIND THE VALUE.

10240 square yards in a Cheshire acre.

$70430 \times \frac{38}{12}$ = area 1 foot thick.

$$\frac{70430 \times 38 \times 80}{10240 \times 12} = \underline{\underline{\pounds 1742 \text{ 8s. 2d. value.}}}$$

EDITOR.

**(No correct answer received.)**

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**ADVANCED,**

*Question 4.*—Give an account of electric blasting.

*Answer.*—In some mines (where blasting is safe) the system of electric firing is the only method of blasting, at other collieries electric firing is scarcely known. There are two kinds of electric shot-firing now adopted, viz.: high tension and low tension, the class most in use at present being the former system. The requirements are—the exploder, the conducting cables, and the fuse or detonator. The exploder appears to consist of a wooden case with a leather strap for carrying it, a couple of terminals for attaching the cable wires, a small crank handle which is easily revolved,

and lastly, a small push projecting out of the side of the case. Inside of the case is a small dynamo machine consisting of an armature a few inches long, with its many coils of fine copper wire, and three or four horse-shoe magnets with their similar poles together, making or forming one large magnet, with its iron pole pieces and brass discs. On the spindle of thə armature is a pinion of brass, into which works a spur wheel gearing about 6 to 1, the detachable crank handle gears into the spur wheel and thus a very high speed is obtainable on the armature, and the energy applied to the turning of the handle is converted into electric power, the current thus generated being conveyed along the cable and utilised in firing the shots. From the armature suitable connections are made to the push and thence to the terminals, so that the connections of the current and the cable are not complete until the push is pressed in. To fire an explosive charge, the exploder is taken within 50 or 60 yards of the face of the drift, the cable is connected to the terminals on the case, the other end is taken in to the face of the level and connected to the detonator and put into the shot-hole with the charge. The party in charge now returns to the exploder (and when all is ready) presses in the push and quickly turns the handle a few times and the charge will be exploded. To fire more than one shot at one time, short pieces of any cheap kind of conductors are required to join up from one shot to another, these pieces are usually destroyed by the shots. All cables consist of two conductors or wires, insulated from each other by layers of tape and gutta-percha. The charge is exploded by an electric spark passing between the ends of the two wires of the conductor and firing the detonator. In the low tension system the charge is fired by a piece of platinum wire becoming white hot, this wire is in the detonator and is joined up to the conductor's wires.

JNO. HARRISON.

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*Question 5.*—At what rate per week could a level, six feet by six feet, be driven in granite, coal shale, and hard carboniferous sandstone respectively, supposing manual power is used, and how would you arrange the working force to obtain the most rapid rate of driving?

*Answer.*—By manual power being used I presume that no steam, compressed air, hydraulic, or electric power is used, and calculate accordingly. In the granite and sandstone I would arrange the force in three eight hours shifts, and four men in each shift. In the shale I would arrange three eight hours shifts, and three men in each shift. In the coal I would arrange four six hours shifts, and two men in each shift, and each shift of men to work in the face until the next shift of men come in to relieve them, and each man to work six shifts per week.

| | | | | | | |
|---|---|---|---|---|---|---|
| In the | Granite | they ought to cut | 5 | yards per week | = 72 | single shifts |
| " | Sandstono | " | 14 | " | = 72 | " |
| " | Shale | " | 20 | " | = 54 | " |
| " | Coal | " | 80 | " | = 48 | " |

not being stopped from any cause, and having sufficient tubs to get away the coal and rock as soon as cut.

JNO. HARRISON.

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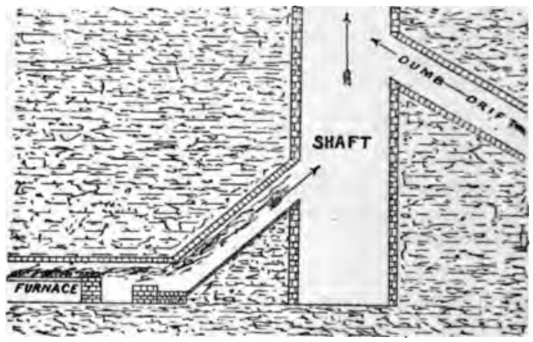
*Question 6.*—How would you arrange the return of a firey mine, ventilated by a furnace, to prevent its contact with the fire?




*Answer.*—In a firey mine it would not be safe to pass the return air current over a furnace, as the danger of the return air coming in contact with the furnace is very great. To avoid this I would feed the furnace with fresh air from the downcast, and conduct the return air through a "dumb drift," so that the flame given off from the furnace could not possibly come in contact with the return. This "dumb drift" is driven from the seam to the pit shaft in the stone roof above the coal, beginning from 50 to 80 yards back from the pit, its rise being, say, from 9 to 12 inches per yard, so that the mouth of the drift will be many yards up the shaft, and at a point above the furnace where the temperature has fallen below the igniting point. Neither feeding the furnace with fresh air, nor carrying the return air current through a "dumb drift" increases the efficiency of furnace ventilation, but on the contrary diminishes it, as not only is the temperature of the air current reduced, but a shorter column of air is heated. Of course, it is much safer in firey mines.

THOMAS WATSON.

### FIRST-CLASS.

*Question 7.*—Make sketches to show how you would timber roads to resist side pressure, top pressure, and where the bottom lifts.

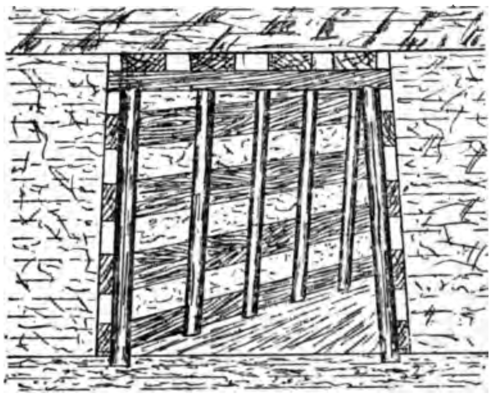


Fig. 1.

*Answer.*—Fig. 1 shows a method of timbering a road to resist side and top pressure where the floor is strong. As will be seen the timber is placed three in a set, and lagging is placed longitudinally next to to the roof and sides. When the pressure is great whole timber should be used for both sets and lagging. When the sides and floor are strong and the roof bad, a bar let into the strata on each side and having lagging placed longitudinally along the roof will be sufficient. Fig. 2 shows a method of

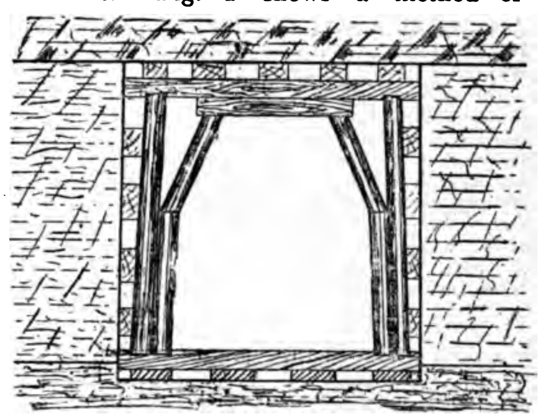


Fig. 2.

timbering where the roof and sides are bad and the floor lifts. In this case the sets have placed under them pieces similar to the collars, lagging being placed under the pieces along the floor similar to the roof and sides. The inside stanchions are put in for a double road where more substantial timbering is required. SAMUEL THORPE.

*Question 8.*—If 50,000 cubic feet of air is circulated per minute by a furnace alone, and 14,000 cubic feet by a steam jet alone, find quantity circulated by both acting together. Also, if 81,000 cubic feet is circulated by furnace and jet combined, find the quantity circulated alone if jet circulates 15,000 cubic feet per minute.

*Answer.*—If we obtain a certain quantity by furnace and another by a steam jet or other means the combined effect will be according to the square root of the square of the one added to the square of the other, and the following formula will be the quantity circulated by both acting together :—

$\sqrt{50000^2 + 14000^2} = 51923$ cubic feet both acting together; also 81000 produced by furnace and jet, and jet alone produced 15000, to find the quantity furnace will produce alone is as the formula, $\sqrt{81000^2 - 15000^2} = 79599$ nearly.

JOSEPH WALLWORK.

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*Question 9.*—How would you arrange for stacked coal being brought back to the heapstead for screening?

*Answer.*—Formerly it used to be a very common occurrence in the North of England collieries to stack coal in a yard exclusively used for the purpose. The whole of this coal had to be filled up into tubs, taken to the screens, and there cleaned before being put into the wagons. To bring this coal back to the heapstead to be screened there are various arrangements, one of the simplest being the inclined gangway. At the top of this incline an engine is placed to haul up the loaded car as the empty descends by gravity carrying with it the rope to bring up the next full one. The gradient being about 1 in 8 or 10. Men are employed to fill the tubs and connect and disconnect them to the rope. In this way a large stack of coal soon disappears and makes room for more coal to be stacked during the dull season. Another method is to fix a small drum on the end of the main shaft of the engine, of a diameter suitable to raise a small cage to the heapstead during each run of the large cage in the shaft. This arrangement is a very good one, and if the apparatus of the cage carries one tub, it is evident that one-fourth of the coal the pit draws can be lifted by this means each day. Hydraulic and steam lifts have also been successfully used, likewise creepers to carry up the tubs to the heapstead.

HUGH HOPPER.

*Question 10.*—A hydraulic pump with piston six inches diameter is wrought by means of a head of water, brought from the surface by a one-and-a-half-inch pipe. Find the pressure on piston, and give weight of water in tube. Depth, 70 fathoms.

*Answer.*—(1st) To find the pressure in lbs. per square inch of a column of water, the vertical height in feet is multiplied by $\cdot 434 = 70 \times 6 = 420$ feet $\times \cdot 434 = 182\cdot 280$ lbs. pressure per square inch at the bottom. (2nd) To find the total pressure on the piston we must first find the area of the same:—$6 \times 6 = 36 \times \cdot 7854 = 28\cdot 2744$ area of pump piston. The height is 70 fathoms $\times 6 = 420$ feet, therefore pressure 420 feet $\times \cdot 434 = 182\cdot 280$ lbs. pressure. The total pressure is found by multiplying the area of the piston by the pressure in lbs. to area $= 28\cdot 2744 \times 182\cdot 280 = 5153\cdot 857632$ lbs., this $\div$ by $2240 = 2$ tons 6 cwt. $1\cdot 857632$ lbs. total pressure. (3rd) The weight of water can be found in more ways than one, but we here show one method, which is simply to square the diameter and multiply by $\cdot 34$. This will find the weight of water in any size of pipe, for 1 lineal foot. $1\cdot 5 \times 1\cdot 5 = 2\cdot 25 \times \cdot 34 = \cdot 7650 \times 420$ feet $= 321\cdot 3$ lbs.

JOSEPH WALLWORK.

## AWARDS

FOR ANSWERS TO ABOVE QUESTIONS.

ELEMENTARY.—Jas. Jackson, 28, Ellesmere Street, Leigh, near Manchester.

*Commended.*—J. Ray, H. Rowson.

ADVANCED.—John Harrison, Ashington Colliery, Northumberland.

*Commended.*—H. Hall, T. Watson, W. Walls, T. Lawrenson, R. Holcroft, F. Garbutt, G. Collins, G. Daykin, J. Cunliffe.

FIRST-CLASS.—Joseph Wallwork, 46, Johnson Street, Tyldesley.

*Commended.*—R. Robson, H. Hopper, J. Smith, J. McPhail, A. McLellan, S. Thorpe.

# CORRESPONDENCE.

### A SELF-ACTING BALANCE BROW.

Sir,—I would be obliged if any of your readers would help me with the following question:—I have an inclined tunnel 6 feet wide, which I am desirous of making into a self-acting balance brow; can this be done without the necessity of laying another line of rails other than those at present in use.—UNDER MANAGER.

## ANSWERS TO CORRESPONDENTS.

RECEIVED.—Colliery Engineer, Invention, Technical World, Universal Index, Mining and Engineering World, Cassier's Magazine (September).

COMPETITION.—We are pleased to say that there is already a remarkable change in the number of competitors in each class of the Competition Questions, and Elementary Students have now little cause for complaint. This is clearly shown by the fact, that in the last set of Competition Answers, not more than one-sixth were Elementary. It is now evident that those who gave cause for complaint, did not realise the fact, and that it was sufficient to call their attention to it.

T.R.—The Schools under the Science and Art Department open for the Session at the end of this month or the beginning of next. Each student is expected to make not less than twenty-two attendances in each subject before the May Examinations.

### BOOK REVIEW.

Cassier's Magazine of Engineering for August, New York. Price 1s. We have seldom, if ever read a Magazine treating with so practical a subject, in which the matter is so interesting and readable. The subjects are well-chosen and are undoubtedly worth the reading of even those who are not directly engaged in the industry: one of the principal features are its numerous illustrations. The principal articles in the issue are—The Ferry Boat of to day, Modern Light-house Service, First Stationary Engines in America, The Earliest Ironclad, Refrigeration from Central Stations, The First Screw Propellor, Biography of Dr. Morton (the eminent science lecturer), The Ideal School of Engineering.

Programme of Technological Examination, Session 1894-95; City and Guilds of London Institute, Messrs. Whittaker and Co., London. Price 10d.

The subjects included in the above Examinations for the coming Session, which apply directly to our readers, are Mechanical Engineering, Raising and Preparation of Ores, Mine Surveying, and Slate Quarrying. The Examinations are in two grades—Ordinary and Honours, each of which have two classes; the Examinations will be held in the month of May. Together with other information respecting the Examinations, the programme contains the Examination Questions given last year.



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# MINING
A JOURNAL DEVOTED TO THE INTERESTS OF MIN...

o 23. Vol. II. SATURDAY, OCTOBER 6, 1894. FORTNIGHTLY. ONE PENNY.


CONTENTS



# ENDLESS HAULAGE.

### THE ENDLESS CHAIN SYSTEM.

IN the endless method of haulage two sets of rails are required throughout the whole length of the haulage road, and the chain proceeds in one endless band from the driving pulley, which is situated near the shaft bottom along one side of the road, round a return sheave at the inbye extremity of the road and back again along the other side of the road to the driving pulley. One set of rails is used exclusively for empty tubs and the other for full tubs, and as the chain moves always in the same direction the full tubs are hauled outbye and the empties inbye.

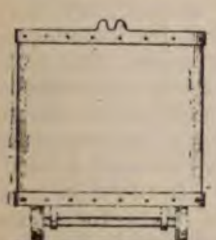


Fig. 1.

Fig. 2.

The driving and return pulleys have both vertical axis and are situated above the level of the top of the tub. In order to create sufficient friction between the chain and the driving pulley to work the road, the chain is coiled round the drum a few times. A layer of boiler plate is fitted round the circumference of the driving pulley, and to this feet are connected at intervals, so that the chain is prevented from slipping and all the wear and tear caused by the chain is done to the feet and not to the wheel itself. Another arrangement to prevent the chain slipping is to attach small forks to the trod of the pulley at equal distances apart in which the horizontal links of the chain catch; by this means it is only necessary to pass the chain half round the wheel. A small roller on a horizontal axis is placed near the sheaves on the side which the chain goes on to guide it to its proper position on the sheave, as the chain being left very slack would not coil on correctly otherwise.

The tubs are put on the road singly at distances varying from 10 to 40 yards apart according to the output, and as the chain passes over the tops of the tubs it is thus prevented from dragging along the floor and no rollers are required. At no time should the distance between any two tubs exceed 40 yards or the chain will drag along the road and thus cause considerable damage by shortening the life of the chain, increasing the work of the engine, and cutting up the haulage road. With ordinary care a chain should last from ten to twenty years, but if it is allowed to drag along the floor for any considerable time a new chain will be required every few years.

The tubs need scarcely any means of attachment, as the weight of the chain resting on the tub is sufficient to draw it along if the roadway is comparatively level, but the tubs are usually provided with a fork constructed with the iron strap at the top of the tub

(Fig. 1) for the chain to catch in. In some mines however the tubs are filled above the height of the sides in which case movable forks (Fig. 2) which in some instances fit into a socket on the tub are employed; the end of the tub to which the fork is attached is placed first when going down hill and last going up.

The engine necessary to work the chain is sometimes placed at the surface, and the chain is conducted down the shaft, but this is only applicable to shallow mines, as the chain becomes an enormous weight if of a considerable length. The better plan is to have the engine situated underground, or if it be decided to have the engine on the surface, which is the safest method when it is convenient, the power may be conducted from the engine to the driving pulley underground by an endless rope.

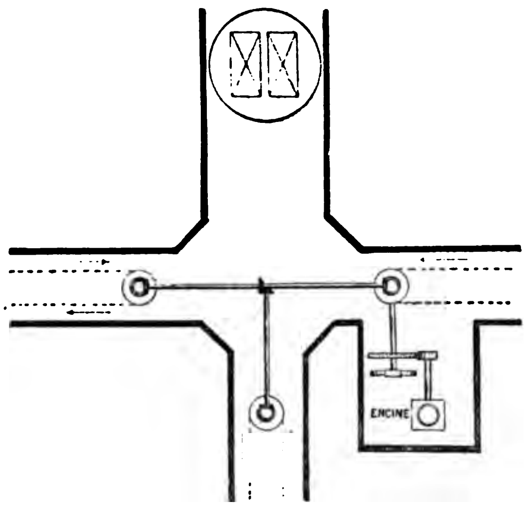



Fig. 3.

When the engine is situated underground the power is transmitted to the driving pulley by shafting and bevel gearing, and in this manner any number of roads in different directions may be worked (Fig. 3); each road has a separate chain and driving pulley and by a clutch-box arrangement, which is attached to each pulley, any one of them may be thrown out of gear without interfering with the others. The handles which work the clutch-boxes are sometimes placed near the pulleys and at others they are placed together in the engine-house and worked by the engine-man.

Branch roads may be worked with facility at any point on the main road by an arrangement of suitable bevel gearing (Fig. 4.) Three chains each with a separate driving

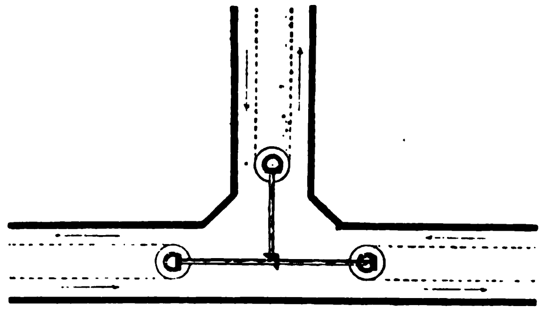


Fig. 4.

pulley with clutch-box attachment are employed as shown, and the haulage on any road may be stopped as required; the tubs on the main road must of course leave the chain at

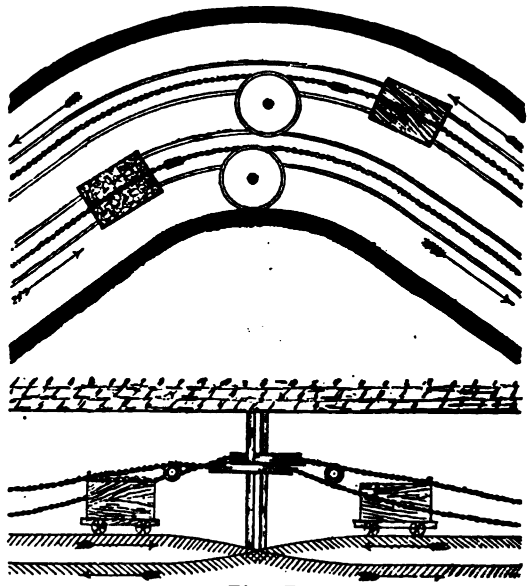


Fig. 5.

the branch and a man or boy will be required to effect the exchange of tubs between the branch and the main road. Another arrangement for working a branch road is to have the pulleys all on the one shaft, but this method does not leave the landing as clear for exchanging the tubs as in the first method.

The chain does not adapt itself very freely to sharp curves, but by introducing two large pulleys at the curve, the chain may be made to work fairly successfully. The arrangement of the pulleys are shown in plan and elevation (Fig. 5), and the chain is guided to each pulley by means of a small roller placed in front of it; the tubs on their approach to the pulleys leave the chain automatically by an arrangement in the level of the road; the road is made to rise a distance from the pulley and to fall again on

reaching the roller which guides the chain to the pulley; this detaches the tub from the chain, and by its own momentum it passes round the curve under the pulley, where it is caught again by the chain after its having left the pulley. This is clearly shown by the elevation (Fig. 5) where the arrows indicate the direction in which the tubs are moving.

(*To be continued.*)

## EXAMINATION QUESTIONS,

WITH ANSWERS BY

JOSEPH CARTER, First-Class Certificated Manager.

WEST LANCASHIRE & NORTH WALES DIVISION (JUNE, 1893). COMMENCED IN No. 18.

### FIRST-CLASS.—Surveying.

QUESTION 22.—When and where do you consider the use of timber "chocks" or "packs" advisable in a mine worked under the longwall system? Describe how you would set them and the method you would adopt to withdraw them.

ANSWER.—It is advisable to set chocks in the longwall system at each corner of a road as you enter off the main road, and in cases where the debris is not sufficient to pack all solid across faces, but wastes between packs have to be left along the working face, then it is desirable to set two rows of chocks across the faces, and as the face advances the back row is taken out and put nearer the face, letting the roof fall in the waste, and this continues all along as a protection to the working face. Chocks are built up of pieces of timber usually about 2 feet in length and from 6 to 12 inches square, made of hard wood, such as oak, ash or elm.

In setting a chock I should put a layer of dirt several inches thick, then lay the pieces on this dirt, and two similar pieces crosswise at right angles to the first two, and this proceeds until the roof is reached, then they are wedged with suitable wedges. To draw chocks I should first of all have the requisite tools required for such work, say hammer, pick, also gabblock and chain, then I should commence to hole the loose dirt from under the bottom pieces and take out these first. Sometimes they are difficult to draw, and at times it is requisite to have resource to a chain of several feet in length, which is put round one of these pieces when freed to a certain extent, but not so as to be able to pull it out without such aid, and more especially is it used when there is a danger of the roof falling when the timber is pulled out. This chain is attached to a gabblock, which consists of a piece of iron bent at one end and with a hook a short distance from the end to fasten the chain on, and the length of the chain is adjusted as the timber is released. The bent end of the gabblock is put behind a firm prop, and the person drawing the timber can be at a safe distance from any roof liable to fall in liberating the pieces of timber. It is well before commencing to draw a chock to see that the place is securely timbered about it, because when the chock is liberated it generally leaves a large open space.

QUESTION 23.—How do you check the accuracy of "sight lines" in driving a main road where the roof is liable to give way?

ANSWER.—In main roads where the roof is liable to fall when putting up "sight lines," I should bore at least three holes in the floor a distance away from the lines and put plugs in, and occasionally by the aid of lamps the lines could easily be tested as they would show any variation in the "sight lines," besides this, I would occasionally check them by the aid of the dial, because it is very important that all main roads be kept as straight as possible; therefore too much care cannot be exercised in keeping the lines accurate.

QUESTION 24.—Define the conditions under which you would make "Theodolite" and "Magnetic" surveys respectively, and describe the modes of plotting?

ANSWER.—The quarterly surveys I would make with a modern dial, fitted with vernier and racking arrangements; I would be guided by the conditions of the mine to be surveyed, whether I would employ the magnetic needle or the vernier; if surveying a longwall face where a magnetic survey could be made with facility I would adopt this method; but in the case of a pillar and stall working where the rails require pulling up frequently I would use the vernier. For any important work such as the laying out of a tunnel to reach a certain point, I would use the theodolite; I would also make a theodolite survey of the main roads every two or three years to check the quarterly surveys made with the dial.

The most common method of plotting mine surveys is with a protractor a cardboard one being the best. The N. and S. of the protractor is made to coincide with the meridian line which is laid down on the plan

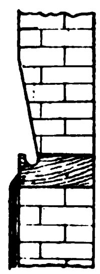
and a parallel ruler is placed on the bearing and on the one directly opposite; it is then parallelled to the station shown on the plan from which the bearing was taken, a line is drawn and its proper length marked off by means of a scale. The same process is gone through for the other bearings. A survey may also be plotted with a scale of chords, by rectangular co-ordinates or by traverse tables.

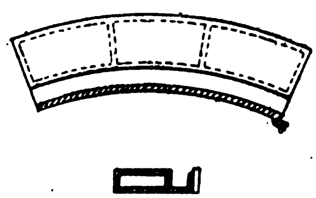
QUESTION 25.—What are "bench marks," "contour lines" and "intermediate sights"?

ANSWER.—"Bench marks" are marks left along a line of survey indicating a series of levels at different elevations. These bench marks are formed by a broad arrow, and in ordinance surveys are cut in stone walls, coping stones, or other permanent and convenient places; they are left every quarter of a mile in long lines of sections, so that the whole would not require to be re-levelled should an error be made in the operation.

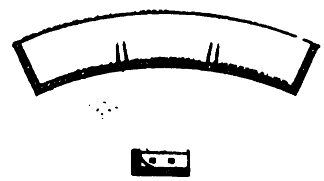
"Contour lines" are the horizontal outlines of ground or works of fortification. It may also be described as a horizontal section of the earth's surface or lines of equal height above the sea level. Intermediate sights are all sights taken at each setting of the level except the first and last.

Section of bricking shewing wooden water ring.





Plan and section of cast-iron water ring.



Plan and section of ordinary bricking ring.

### Shafts.

QUESTION 26.—What special precautions would you ensure being carried out in the signalling arrangements when sinking a shaft?

ANSWER.—I would arrange a special code of signalling for sinking as the circumstances required. To ensure them being carried out, I would have the rules printed on boards and one posted up on the pit bank for the guidance of the banksman and those persons who work below, being careful to place it in a very conspicuous place so that it could easily be seen and read. I would post another copy in the engine-house for the guidance of the engine-man; besides this, I *would give* written instructions to the engine-man, banksmen in charge, and the chargemen below ground, that they must comply with the rules posted up and hold them responsible for the carrying out of such rules.

QUESTION 27.—Describe and give sketches of water and bricking rings, and the lining of shafts? How far apart would you have the supporting rings? Give reasons.

ANSWER.—A water ring may be made either of wood or cast-iron in segments, each segment one-tenth the circumference of the pit; the water rings now used are chiefly of cast-iron, and in laying one of them, a place is selected in the pit a short distance below the place where the water is made, and underneath this again is placed an ordinary bricking ring about 2 feet below, then a good bed is made for the ring to rest on; this is built up and cemented and concreted to the bed of the water ring; here again the brickwork is set back and the space behind it is puddled well with clay. Round the shaft are left small holes forming pigeon holes or weeping holes. The joints are lined with pieces of timber and tarred flannel so as to make them water-tight. The water is then conveyed down the shaft by means of water pipes, and when it is delivered into the pipes it is better to have a tank, say about 2ft. 6in. deep, 1ft. 6in. wide, as a settling tank for the dirt and sediment to lodge in, so as to prevent the pipes from being racked up with dirt, because the tank can easily be cleaned before it is quite full. Ordinary bricking rings may be either of wood or cast-iron and cast into segments, the cast-iron segments are strengthened by two cross ribs and two end pieces; each end piece has two holes in to allow the bolts to pass through to connect the segments; in laying a ring the place must first of all be prepared and made perfectly level, then it is laid down and wedged behind to withstand a good pressure, because it is used for a foundation for walling of the shaft. Underneath each segment I would drill two holes and put in two strong iron plugs as supports for the ring and brickwork.

The lining of shafts is the method of walling round the shaft which is usually done with bricks. The walling, commencing from a crib or ring, proceeds upwards, a circular scaffold being used which can easily be raised when the walling has got too high for the workmen, and this proceeds until the walling is completed. I would have a distance of 10 yards between the rings, my reason for this being greater safety to the men by having the shaft walled up in short lengths, because the sides are liable to become loose when open too long, thus becoming dangerous to the men employed below.

Question 28.—A shaft 16ft. in diameter and 400 yards deep, fitted with wire rope guides and two cages, is used for winding coal in the day time. It has to be sunk in the night time 100 yards deeper. Describe how you would do this and what precautions you would observe?

Answer.—To do this I would make the necessary arrangements requisite (at the bottom of the shaft) for commencing such work, viz.:—make room to receive the debris during sinking, have a separate and independant siding for it, so as not to interfere with the ordinary working of the mine, though the dirt could be taken into the workings of the mine if there is sufficient storage room, if not, I would send it up the shaft during the day time. I would erect a platform for receiving the kibble when landing at the mouthing as a protection to the sinkers whilst changing the kibble, for this purpose I would arrange two doors which are counter-balanced and connected by levers, with two hinges bolted on the doors and keyed on cross shafts. These doors are opened and closed by means of a lever. I would have a rope 100 yards long (an ordinary winding rope should be used), which should be capped at each end, and when in use one end would pass through the bottom of the cage and be fastened to the short coupling chain below the capping of winding rope. When not in use I would wind it on a reel or drum which I would have placed on one side so as not to interfere with the working of the mine in the day time.

The precautions I should use would be to have the winding shaft thoroughly examined before the commencement of each shift as well as the portion in sinking, and for this purpose should appoint some competent person to examine and see everything safe before commencing work, and enter same in report book of mine.

(*Concluded.*)

## COMPETITION QUESTIONS.

(See particulars of Gold Medal Competition on cover.)

To the sender of the best set of Original Answers in each Stage will be awarded the following:—
**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best answer to each question will be published with the sender's name and address.

1.—All envelopes must be marked "Competition."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by October 19th, 1894.
5.—The Editor's decision as to winners to be final.

### ELEMENTARY.

*Question 1.*—Describe, with suitable sketches how the junctions and landings of the wagon-roads underground are made. Explain under what conditions each are used.

*Question 2.*—What is the cause of acid water in mines, and how are pumps protected against its action?

*Question 3.*—What are cannel, hard steam coal, and anthracite, and where are they chiefly found in the United Kingdom?

### ADVANCED.

*Question 4.*—Give an account of the Somersetshire coalfield, and of its relation to the carboniferous strata east and west of it. Give sketch map.

*Question 5.*—How should steel-wire drawing ropes be handled, when in use, to prevent accidents from sudden breakage?

*Question 6.*—Describe the different methods employed in gearing rope drums to winding engines, giving sketch of an example, with dimensions.

### FIRST-CLASS.

*Question 7.*—If the current in an underground road, six feet square, is maintained by a pressure represented by one inch of water-gauge, what pressure per square foot will be required to pass the same quantity of air along a road five feet square, both roads being of the same length?

*Question 8.*—A coalfield having an area of 2,000 acres contains a vein of coal seven feet thick, free from faults, but one part of the field the coal is 120 yards deep, and at the deepest part 480 yards. Assuming that the surface is level, which is the best place to open out and mine this coal by shafts? What method of mining is most suitable, and what sized pillars should be left for protection of shafts? Give sketches if necessary.

(*Answers to above will appear in No. 26.*)

# CONVERSATION ON STEAM BOILER EXPLOSIONS

**By a PRACTICAL MAN.**

CONTINUED FROM LAST ISSUE.

*(Specially prepared for "Mining.")*

QUESTION.—What provision is made for strengthing boiler flues?

ANSWER.—In modern well-constructed steam boilers, the tubes are strengthened by rings of a T Section or of a corrugated section, these rings being rivetted to the tube at intervals of about $3\frac{1}{2}$ feet; this, of course, has reduced the liability to collapse, and has added greatly to the security of boilers.

QUESTION.—But suppose the tubes have the same diameter and length, and that they only differ in thickness of plates, what is then the ratio of their powers of resistance?

ANSWER.—According to Sir W. Fairbairn, the strength of tubes of the same length and diameter but of different thicknesses, varies as the 2·19th power of the thickness.

QUESTION.—What is meant by the 2·19th power of the thickness?

ANSWER.—We mean by the power of a number, the number of times it has to be multiplied by itself. Thus the 3rd power of 2 is 8, that is $2 \times 2 \times 2$, and is expressed thus $2^3$ For calculating practically the varying strength due to a difference in thickness, we may say that the strength varies as the square of the thickness. Suppose we have two tubes of equal lengths and diameters, but whose thicknesses are as $1 : 3$, then the strength of the tubes would be as $1^2 : 3^2 = 1 : 9$, so that it will be seen that the thicker tube will have nine times the strength of the thinner tube.

QUESTION.—In the case of a Lancashire or Cornish boiler is there not a danger in the flues expanding?

ANSWER.—Yes, unless provision be made. It must be remembered that if the tubes get very hot they not only lose their power of resistance, but they also expand very much longitudinally, and if no provision be made, the boiler ends are in danger through the pressure of the ends of the tubes against them.

QUESTION.—What provision is made for the expansion and contraction of the tubes?

ANSWER.—There have been many plans resorted to for giving freedom of action to the flue when subjected to differences in temperature, the principal contrivance being the "Bowling hoop," which consists of a corrugated ring or hoop, which unites the several lengths of tube together by rivetting. This form of flue construction not only makes provision for the expansion and contraction of the flue and tube, but also materially strengthens the tube in resisting collapse at the edge of the plates.

QUESTION.—Are there not other causes from which boilers are likely to suffer?

ANSWER.—Yes, one of which is the accumulation of deposit on the bottom of the boiler or on the flue plates.

QUESTION.—What is the cause of deposit on bottom or sides of the boiler?

ANSWER.—Most water contains solid substances in solution and suspension. As the water is evaporated, the solid matter is deposited, the water passing off to do work as steam, and the sediment to the bottom and sides, &c. of the boiler.

QUESTION.—But does not the sediment be carried off with the steam?

ANSWER.—Not likely. If the sedimentary substances must leave the boiler they must do so when the boiler primes (that is, passes off water with the steam) which of course, is in itself a great evil and should be avoided. Sediment is also got rid of sometimes by blowing off.

QUESTION.—What do the impure substances contained in the water usually consist of?

ANSWER.—They may be termed mineral, organic and mechanical impurities. Mineral impurities result from the passage of the water over the earth. They consist chiefly of carbonate of magnesia, carbonate of lime, soda, sulphate of soda, potash, &c., proportionate to the nature of the soil.

QUESTION.—What effect has sediment on boilers?

ANSWER.—If neglected, it becomes a great source of danger; it gets thicker and thicker, and as it lies between the water and the plates, the plates become excessively hot. As this goes on the plates lose their strength and an explosion might occur.

QUESTION.—How then is muddy water, or water containing impurities to be dealt with?

ANSWER.—Where the feed water is muddy, Hotchkiss Boiler Cleaner is said to remove deposit and scum from the water very effectually. Seales Patent Water Purifier, as applied to some Lancashire boilers, is a simple means of purifying the feed water, and it can be applied to any existing boiler.

There are many other appliances in use for purifying feed water for boilers and explosions need not occur from this cause.

*(Concluded.)*

## ANSWERS TO QUESTIONS
**In No. 20, Vol. 2.**

### ELEMENTARY.

*Question 1.*—What are bituminous, free-burning, and smokeless coals? Give an example of each.

*Answer.*—BITUMINOUS COAL.—Black of various shades, streak, sometimes greyish black; lustre more waxy than that of anthracite, in some varieties dull; fracture sub-conchoidal to uneven, the substance often divided by cleats or joints into parallel-faced figures—cubical coal, dicey, etc.; specific gravity, 1·25 to 1·4; composition generally from 73 to 90 per cent. of carbon, 8 to 22 per cent. of oxygen, hydrogen, and nitrogen with (as in anthracite) a variable amount—3 to 30 per cent.—of earthy matter constituting the "ash."

FREE-BURNING COAL, more generally called semi-bituminous coal, has a less mineralised appearance than anthracite, and consequently a large amount of hydro-carbon remains. It contains 12 to 18 per cent. of volatile matter; its colour is dull black; has a sub-conchoidal fracture; burns with more abundant flame than anthracite; gives off more smoke, but not in dense volumes; it does not cake together; it is sometimes called steam coal; specific gravity is about 1·40. The coke obtained from coals of this class is useless for commercial purposes.

SMOKELESS COALS much resemble anthracite, but not so hard and strong. It burns with more or less flame, scarcely soils the fingers, and has a composition similar to anthracite, viz.:—carbon in great proportion—generally 90 to 95 per cent.—hydrogen, oxygen, and nitrogen in minute quantities; specific gravity 1·3 to 1·75.—JOHN STEPHENSON.

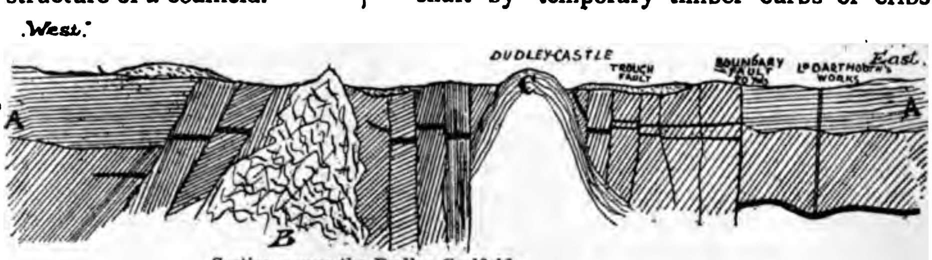
*Question 2.*—Describe, with illustrative details, the general structure of a coalfield.

small area. They are found to incline (dip or pitch) more or less regularly from the moderate angles of six or eight degrees to as much as twenty-five or thirty degrees—a "sharp pitching"—or even, in exceptional cases, to seventy or eighty degrees—rearing or edge seams. Whatever happens in this way to one of the beds the others are similarly affected, because the strata throughout this system or group are all conformable or parallel. The inclined position of the beds will necessarily bring them at some point or other to the surface, unless they are overlaid by some newer formation deposited unconformably upon the ends of the up-turned strata. When the beds dip for awhile and then ascend or rise they form a trough or saddle, and when they rise on all sides towards the surface, as in the Forest of Dean, they constitute a basin. In addition to this general disturbance from the original position in which the beds must have been deposited they have been cut through by inclined planes of fissure, and so dislocated that they are now lower on the one side of the line of fault than on the other. A great number of these troubles within a small space may render a seam of coal so "faulty" as to be worthless. A very thick seam will rarely be of clean coal throughout: partings will occur of clod or various earthy material, which, if of a few inches, may not occasion much inconvenience, but if they get to be more than eighteen inches or two feet may practically interfere with the possibility of working advantageously. Iron pyrites or brasses will sometimes run with a line of parting, and need to be carefully picked out.—JOHN STEPHENSON.

*Question 3.*—Describe and illustrate the use of timber in securing a round or rectangular mine shaft.

*Answer.*—In fragile ground, such as sand and gravel, the commencement is to secure the shaft by temporary timber curbs or cribs

A Lower Red Sandstone
B Whin or Trap
C Limestone




Section across the Dudley Coalfield.

*Answer.*—Whatever may be the form of the surface of the ground it rarely happens that the coal measures under it, whether deep or shallow, lie in a flat position for more than a

formed of segments of wood prepared to fit the dimensions of the shaft, and having their joints in the direction of the radii of the circle, will, when four, five or six inches square, resist a

heavy pressure from the sides. They are supported at intervals—generally of about three feet—by upright or punch props, and are, as it were, hung together by thin planks termed stringing deals, which are nailed against them, whilst the whole structure may be temporarily suspended, if occasion arises, by attaching it to a couple of stout baulks laid across the top of the shaft (hanging baulks). Behind the cribs a backing is formed by driving down planks of some six feet long (backing deals) close together in bad ground, or at small intervals in favourable rock. When a firm foundation of stone or bind has been reached a bed is prepared with hacks or chisels to receive a broader curb of either wood or cast-iron, and on this a wall of brick-work is built up to the surface, or above it when tip room is required. The pit is then re-commenced, of smaller diameter at first, but afterwards opened to its former dimensions, and at a suitable place a fresh length of walling is begun, and carried upwards till, by careful adjustment, it is made to coincide with the upper length and to join up to its curb. Circular shafts vary from about eight to more than twenty feet in diameter, but a good working size for a large output of coal may be taken at from fourteen to eighteen feet.—

JOHN STEPHENSON.

*(For Sketch see No. 7, Vol. II.)*

### ADVANCED.

*Question 4.*—What methods have been employed to prevent flame in the use of explosives in collieries?

*Answer.*—There are various methods employed to prevent igniting coal dust or gas by the firing of shots in mines, the method most generally adopted being that of the "water cartridge," which is considered by various authorities to the most efficient and safe. As to the safety of the water cartridge I can quote no better authority than that of the Royal Commissioners on Accidents in Mines who say:—"The so-called 'high' or violent explosive agents which are represented by dynamite or gelatine-dynamite, and by gun-cotton or tonite can now be applied, not only for working economically in stone or shale, but also for coal getting by using them in conjunction with water, according to one or *other of the methods* described in the report."

THE WATER CARTRIDGE.—This is intended to prevent the production of flame from a shot in blasting, so that if used in conjunction with an electric battery for firing the charge, it might give absolute safety in fiery mines by rendering blasting practicable without the presence of any flame. As now used the water cartridge requires a hole about 2½ or 3 inches diameter. This is the diameter of the long waterproof bag. The cartridge, with fuse or electric wires attached, is fixed in a tin case with projectors at each end. These projections fit against the ends and sides of the waterproof bag, so as to keep the cartridge in the centre. The bag, with the cartridge inserted, is then filled with water, and the mouth of it securely tied. It is then placed in the hole, tamped, and fired in the usual way. Any burning matter, whether solid or gaseous, from the shot must either force the water out first or pass through it.

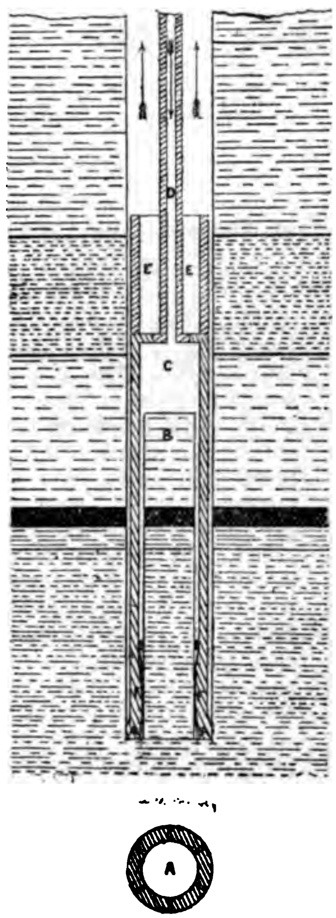
Mr. MILES SETTLE's patent improved water cartridge is the one which is most generally approved of owing to its high efficiency. It is so contrived that the explosive is totally and equally surrounded by water in and under all conditions. The fuse is fired by electricity, and although it has been put to some of the most crucial tests—being, for example exploded in a barrel of gunpowder, in blown-out shots, in coal dust, etc.—no flame has been observed. The makers of "securite" have a flameless cartridge case which may be used with it or other explosive, to extinguish any flame that may be produced when it explodes.

TRENCH's fire-extinguishing compound is an invention to extinguish the flame of the shot by surrounding the explosive cartridge with sawdust which has been treated with certain chemical substances. Experiments go to show that dynamite and other explosives surrounded with this mixture and fired show no trace of flame.

FLAMELESS EXPLOSIVES.—There are several manufacturers who profess to make flameless explosives, but only a few of these may be said to be practically flameless, among which may be included roburite. Certain substances are mixed with the explosive in the manufacture, which on being exploded form gases which quench all flame.—MYLES BROWN.

*Question 5.*—Describe, with suitable sketches the diamond method of rock boring.

*Answer.*—The "diamond" rock-boring system although very expensive has the great advantage that very accurate samples of the ground passed through are obtained. The tool consists of a tube which is set with black diamonds. It is revolved by machinery, the motion being conveyed to it by strong rods. It then cuts out an annular space forming a solid cylindrical core in the centre of the hole. This core is removed from the hole at intervals. The hardness, composition, and texture of each kind of rock can be more correctly ascertained from these cores, and they also shew the gradient of the strata and the thickness of each bed. In this method the action is rotary, the rods being turned continually round, thus wearing out the bore hole by steady friction, the rods being hollow. Water is forced down the hollow boring-rod to bring up the pulverised stone, and also to keep the diamonds cool. A sediment tube is screwed on the top of the core tube to collect the debris forced up by the water. The whole is made to rotate by a small engine. Near the bottom or crown of the core tube is an expanding ring which allows the core to pass up into the tube, but immediately the tube is raised up the core is broken off at the bottom from the natural strata, and is held in the tube by the expanding ring. The Diamond Rock Boring Company's price for boring is 8s. per foot for the first 100 feet, 16s. per foot for the second 100 feet, 24s. per foot for the third 100 feet, and so on, increasing by 8s. per 100 feet. In very deep boreholes, and when stone of unusual and unexpected hardness is encountered special prices are arranged to suit the circumstances. The annexed figure shews the vertical section and plan of the bottom end of what is called the bore piece. The dark blotches on the figure shew the diamonds in plan and vertical section. It will be seen that the diamonds are so situated as to make the hole a little larger than the bore tubes and to make the core a little smaller than the interior diameter of the bore tubes. The diamonds used are of the black variety from Brazil and the Transvaal. The diamonds are caulked into recesses specially cut for them.—MYLES BROWN.

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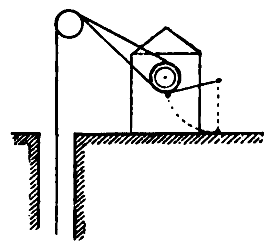
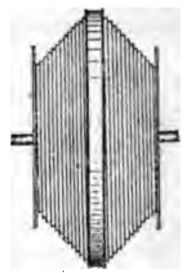
*Question 6.*—What methods are used for equalising the load on winding engines? Give sketches.



Pendulum System.



Spiral Drum.

*Answer.*—(1) THE PENDULUM SYSTEM.—This consists of a wooden beam, fifty feet long, suspended at the upper end by a hinge joint, having a load at the lower end in proportion to the weight of the rope. If the cage was at bank the pendulum would be horizontal, being lifted by a drum fixed on the engine shaft, having a chain passing over a pulley. When the cages meet in the middle of the shaft the whole of the chain constituting the balance is off the roll, but after this the roll commences to wind on all the chain in the opposite direction, and the pendulum gradually assumes a horizontal position. Thus the weight is always in position to exert its greatest power when the ropes are most out of balance.

(2) THE SPIRAL DRUM.—This is for round ropes, and is sometimes called the conical or scroll drum. It is made of two diameters, and the barrel is thus inclined or conical, as shewn. Thus, while the rope on one side is being wound on coils upon an increasing diameter, the one on the opposite side coils off a gradually decreasing diameter. At Boldon Colliery, in the County of Durham, there is a conical drum thirty feet in the centre at its

greatest diameter, and nineteen feet at the sides where its diameter is least. Spiral drums are considered to be the best, but they are very unwieldy and a heavy dead weight to start and stop at each winding. Sometimes they are plain and ungrooved, but they are much safer when formed with grooves for the rope to work in. The object of the spiral drum is to counter-balance or equalise the load upon the engine. In the spiral drum the diameters are proportioned, and the strain upon the engine is uniform from the beginning to the end of each winding. The diameter of the drum is least when it commences to raise the full cage from the bottom, and greatest on the side of the descending cage. The former thus has the least leverage with the greatest weight, and the latter the greatest leverage with the least weight. These conditions alter during the process of winding, with the result that the work of the engine is balanced at every part of it.

(3) Chain and Staple.—In this counter-balance arrangement a chain winds upon a small drum keyed upon the main drum shaft, and uncoils also a staple or small shaft usually placed behind the engine. To the end of the small drum chain heavy chains are attached. When the cages are at the top and bottom of the shaft these chains are hanging in the staple. During the process of winding they are lowered to the bottom of the staple, and are completely at the bottom when the cages are at "meetings." As the cages pass each other the chain upon the small drum winds in the opposite direction and gradually raises the heavy chains until, when the winding is finished, they are in the same position as at the start. Up to the point of meeting the ascent of the full cage is thus assisted by the heavy chains; thereafter it is retarded.

*(Sketch in No. 18, Vol. II.)*

(4) Tail-Rope under Cages.—This is another method of counter-balancing, and is applied with a plain cylindrical drum. It consists of a rope passing round a pulley placed near the pit bottom and attached to the bottom of each cage. The ascending cage draws the rope round the pulley and up the shaft, thus rendering the weight of rope upon the engine always about uniform. The engine is thus enabled to start the cages more easily, and perform the winding quicker. It should be noted that the strength of the winding ropes should be increased in proportion to the weight of the tail-rope when drawn up to the surface by the ascending cage. Another method is that of the inclined plane on which a tram (weighted) travels. The principle is the same as the foregoing, hence it is un-necessary to explain it in detail.

*(Sketch in No. 21, Vol. II.)*

Myles Brown.

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**FIRST-CLASS.**

*Question 7.*—How is creep and thrust brought on, and what would you do to prevent it?

*Answer.*—Creep and thrust is brought on when the pillars left in to support the roof are not sufficient to carry the weight of the over-lying strata, and consequently are crushed into small. Then if the roof and floor are soft the former is forced down in the centre of the roadway, and the latter is heaved up or squeezed out to such an extent that they both meet in a short time by the pillars being crushed into it. Also where a hard roof is prevalent and the floor soft the above generally arises. When the creep is started it is not easily prevented, therefore the best method is to rip the affected roads at the top and bottom and build strong packs at their sides, taking care to have as few roads as possible to advantageously work the mine, and to leave the pillars much larger than formerly so as to form a greater base for resistance to the pressure. These regularly occur in long-wall workings where the floor is fire-clay, when by the crushing of the goaf the road heaves to a great extent, and necessitates the ripping of them regularly.—John McPhail.

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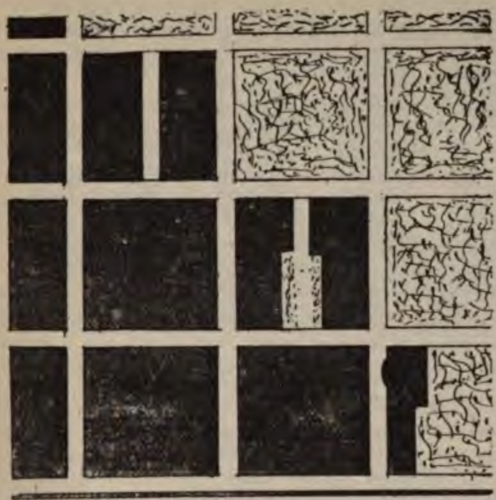
*Question 8.*—Describe, with sketch, how you would win the pillars in a mine subject to creep, or over which creep has passed?

*Answer.*—The accompanying sketch shews how the pillars could be won in a mine subject to creep, which consists of starting at the in-bye end and driving a road into them about four yards wide right through the pillar, then coming back and taking another two lifts or so in the same direction, always leaving in a piece of coal in order to keep the men safe, when as much may be ripped off as can be gotten with safety, and small pieces left in which are not safe to approach, care being taken to pack the sides of the lifts and to keep the timber in



a line with the men as they proceed. The pillars should all be a little in advance of each other when being removed, as the roof can be carried much better.—JOHN McPHAIL.

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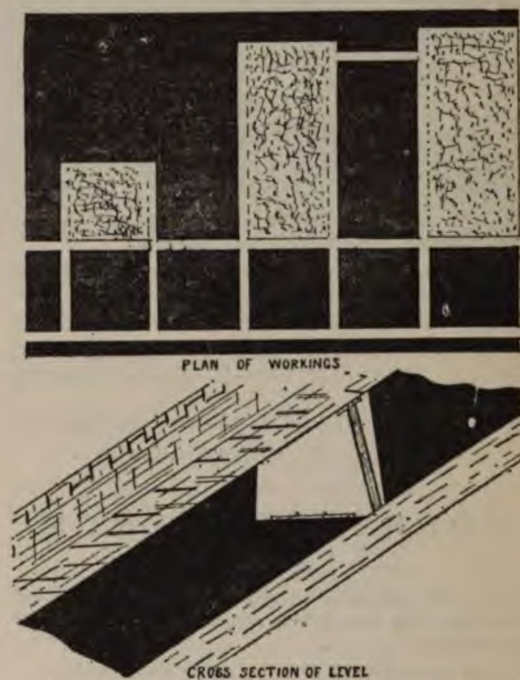
*Question 9.*—What percentage of coal would you take out at first working a seam at 60, 150, and 200 fathoms, average roof and pavement? Give size of stoops and width of rooms you would adopt to get the largest amount of coal possible, consistent with economy and safety?

*Answer.*—The percentage of coal I would take out of the seams at different depths would depend on their thickness. I presume by the question that the method of working in each is pillar-and-stall, therefore as the depth increases so does the size of pillar, and assuming the seams to be of the same height, a higher percentage will be obtained from the seams nearest the surface. So that the amount I arrive at is:—20 per cent. from the seam at 60 fathoms; 14 per cent. from the seam at 150 fathoms; and 10 per cent. from the seam at 200 fathoms; to be taken out in the first working. The size of stoops may be calculated from the following rule:—Allow 10 square yards of coal for every fathom in the depth of shaft. Then $\sqrt{60 \times 10} = \sqrt{600} =$ 24·5 yards, size of side of pillar. Also, $150 \times 10 = \sqrt{1500} = 38{\cdot}7$ yards, and $200 \times 10 = \sqrt{2000} = 44{\cdot}7$ yards, which are the lengths of sides of the stoops required for the respective depths. The width of rooms varies from 7 to 12 feet according to the thickness of seams, but for a 6-feet seam 10 feet wide is an ordinary width for a room, to work with economy and safety.—JOHN McPHAIL.

*Question 10.*—Sketch and describe some methods of working highly-inclined coal seams.




*Answer.*—In working highly-inclined coal seams many methods are in use which vary according to the inclination. Where two or three seams are to be worked from the same shaft, a stone drift commencing at the shaft and intersecting the seams in consecutive order, so that they can be wrought back by long-wall, and two or three different coals brought out at the same shaft, so that a large output can be obtained from a limited area. In working the rearing seams the two principal methods are as follows:—First, a level is driven into the coal, and panels formed about 400 feet square. In each of these panels two roads 12 or 14 feet wide are driven to the rise 50 feet apart, and roads 15 or 20 feet wide are broken away level course every 50 feet. These roads are connected every 100 feet, and when the boundary of the panel is reached these pillars are worked back.

In the second method two roads 20 or 30 feet apart are broken off to the rise, which are connected when they have gone 30 feet, and a breast opened out, the coal being extracted as the roads go in and the roof being allowed to fall between the roads. Where the inclination is steep enough the coals fall down the road, which is sometimes covered with sheet-iron

to aid their descent, the ventilation being directed by connections when the ribs of coal between these faces or breasts are wrought back after the boundary is reached. See sketch, which illustrates this method.—
JOHN MCPHAIL.

## AWARDS

FOR ANSWERS TO ABOVE QUESTIONS.

ELEMENTARY.—J. Stephenson, Wharton Street, Coundon, Bishop Auckland, Durham.

*Commended.*—J. H. Berry, Shadrack Chadwick, G. D. Dobinson.

ADVANCED.—Myles Brown, Butterknowle, Darlington.

*Commended.*—S. Thorpe, Hy. Talbot, D. W. Irvine, W. P. Laws, G. Daykin, G. Deverill, J. Fox.

FIRST-CLASS.—J. McPhail, 6, Sourlie, Irvine, Ayrshire.

*Commended.*—Herbert Hall, J. Harrison.

# CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.

Envelopes to be marked "Correspondence."

Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

Correspondence must not be enclosed with Competition Answers.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

### A GRACIOUS ACKNOWLEDGMENT OF A KINDLY CRITICISM.

Sir,—I beg to acknowledge the kindly criticism and correction of MINING STUDENT in reference to answer of mining problem answered by myself.

When answering the question I was guided by an answer to a similar question which occured in the *Colliery Guardian* some years ago. But on reverting to the clear reasoning of the solution, and also sketch, as submitted by MINING STUDENT, I am bound to admit his solution is the genuine one. D. SPENCE.

### MINING PROBLEMS.—QUERIES.

Sir,—I would be pleased if you would insert the following questions, and thankful if any of your able readers will answer the same:—

(1) A colliery produces, per week, 6,500 tons of large coal and 1250 tons of small coal. The wages cost on the total output is 3s. 4½d. per ton. What is the cost per ton of the large coal when it is debited with the entire wage expenditure, and credited with the *value of the* small coal at 2s. 10½d. per ton?

(2) Describe the construction and action of a maximum and minimum thermometer, and give a sketch of the instrument.

(3) Would the graduation of the tube be affected by altering the capacity of the bulb? Give the reason for your answer. IMPROVER.

[Description and illustration of maximum and minimum thermometers appeared in No. 20, Vol. I.—ED.]

### MINING PROBLEMS.—ANSWERS.

Sir,—In answer to OVER HULTON's queries in No. 20. Vol. II, I offer the following solutions to Nos. 1, 2 and 4,

(1) O. H. does not state whether the water ran into the mine in 5 hours or not, but I will say 5 hours. Then if there were 20,000 gallons in the mine the quantity per hour would be $\frac{20,000}{5} = 4,000$ gallons per hour. If O. H. wants to know (which I think he does) how many gallons per hour the engine pumped with a useful effect of 66 per cent., then I should say the following is the number of gallons per hour pumped:—

$\frac{4,000 \times 100}{66} = 6060 \cdot 6$ gallons per. hour.—*Answer.*

(2) Taking the specific gravity of coal at 1·25 (which is a fair average) the weight of a cubic foot of coal would be 78·1 pounds. This is found as follows:— Water is 62·5 pounds per cubic foot; therefore to find the weight of a cubic foot of coal when the specific gravity is known: $62 \cdot 5 \times 1 \cdot 25 = 78 \cdot 1$ pounds.—*Ans.*

(4) To calculate the breaking strain of hemp, iron wire or steel wire ropes:—

Circumference squared + 4 = breaking weight of hemp rope in tons.

" " × 1·5 = breaking weight of iron wire rope.

" " × 2·5 = breaking weight of steel wire rope.

Therefore, $3 \cdot 1416 \times \frac{5}{8} \times 2 \cdot 5 = 9 \cdot 638$ tons breaking strain for ⅝-in. steel wire rope. Breaking strain of a ⅝-in. chain is 9 tons. W. S.

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—Technical World, Universal Index, Invention; also Manager, M. Chapman, Aitchison, Exam., Westhoughton.

IMPROVER.—When asking queries in our correspondence columns the sender should not give too many at once or it is probable no one will take the trouble to answer the lot. We have only published three of the questions sent by you, the others will appear next issue

J. B. PYE.—There are several good books on the subject and we can hardly advise you which to get. Of course the better the book the more expensive it will be. Send on stamp and price you wish to give and we will forward you a list.

W. T. & OTHERS.—Many thanks for your suggestions *re* Competition Questions. It will be seen we have carefully studied them, and as a result we give this issue particulars of Gold Medal and other Competitions.

C. COLLIER.—We have sent you the information as requested. For other particulars *re* Examinations see No. 7 of present volume.

J. H. SENIOR.—We have written you.

*Printed and Published* by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINI[NG]
A JOURNAL DEVOTED TO THE INTERESTS OF MINI

o 24. Vol. II. SATURDAY, OCTOBER 20, 1894. FORTNIGHTLY. ONE PENNY.

CONTENTS



## EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in No. 2, Volume II.*

(CONTINUED FROM NO. 22.)

SURVEYING WITH THE MAGNETIC NEEDLE IN THE PRESENCE OF IRON.

A CORRECT survey may be made with the magnetic needle alone in the presence of iron providing one correct bearing is obtainable or a known datum line is laid down. The method, however is not much used, as a fast-needle survey can be made with only the same amount of trouble and with greater accuracy, but circumstances may arise such as the loss of the clamping screw which render a fast-needle survey impossible, in which case the method which may be termed the "correcting deflection" method may be advantageously adopted.

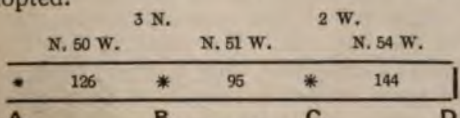



Fig 75.

Take fig. 75 as an example of a roadway which is to be surveyed, and that the point A is the only one at which the absence of iron renders a correct bearing possible. The instrument is fixed at A, and a bearing is taken towards B, which we will presume to be as far as a light can be conveniently seen from A. The bearing being read off is found to be N. 50 W., and as there is no attraction on the needle this is a correct bearing, and is booked accordingly. The remaining bearings of the road must be calculated from this. The dial is now removed and fixed at B, directly under the mark at which the sight lamp was held, and a back-bearing is taken to A. This should read N. 50 W. as it is the same line of sight as was previously taken, but owing to the local attraction of the needle the bearing is found to read N. 47 W. Thus it is plain that the needle has been attracted three degrees north of its true course. A fore-sight is next taken to C, and the bearing reads as N. 48 W. But as the dial has not been moved the needle is still attracted three degrees north, therefore the correct bearing is $48 + 3 =$ N. 51 W. The instrument is now removed to C, and a back-sight is taken to B. This is found to read N. 53 W., and as the correct reading as calculated from the correct bearing is N. 51 W., the needle has been deflected two degrees to the west. A fore-sight is next taken to the end of the road D, and the bearing is read off as N. 56 W., but as the deflection is the same as was previously ascertained by the back-sight, namely:—two degrees west, the correct bearing is N. 54 W. If the instrument was then placed at D, and the needle was free from disturbance, a backsight to C should give the bearing N. 54 W., and a check on the work would be thus obtained.

It may so happen that a correct bearing cannot be taken at the commencement of the survey, in which case the readings of both back and fore sights must be recorded and the correct bearings calculated when a bearing

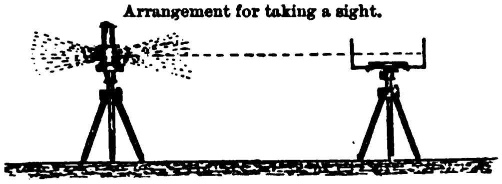
has been taken where the needle has not been attracted. The following shews a method of booking the foregoing survey, presuming D to be the only position at which a correct magnetic bearing can be obtained. The instrument would first be placed at B.

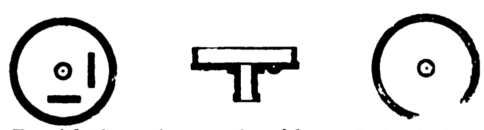
| No. | Back bearing. | Fore bearing. | Correct bearing. | Distance |
|---|---|---|---|---|
| 1 AB | N. 47 W. | | N. 50 W. | 126 |
| 2 BC | N. 53 W. | N. 48 W. | N. 51 W. | 95 |
| 3 CD | N. 56 W. | N. 54 W. | N. 54 W. | 144 |

*Correct bearing as obtained with magnetic needle N. 54 W.*

To obtain any degree of accuracy it is necessary when re-setting the instrument to place it exactly at the mark to which the last foresight was taken. The best method of doing this is to have three sets of legs, any of which will fit the dial. One set is sent ahead for the foresight, and one remains behind for the back-sight, the other being used for the instrument at the intermediate station. A metal cup fitted with two levels (fig. 76) placed

Arrangement for taking a sight.





Foresight Cup. Cross-section of Cup. Backsight Cup.

Fig. 76.

at right angles to each other at the bottom of the cup is fixed on the legs at the fore-sight. The pivot of the legs on which the dial fits is made to assume a truly perpendicular position by adjusting with the levels, and the sight lamp is placed in the cup. By these means the centre of the light of the lamp is exactly in the same perpendicular line as the pivot of the legs. The legs at the back-sight have also a similar cup minus the levels. The levels are not necessary as the legs have been previously occupied by the dial, except in the case of the first back-sight, when the levelling cup is used.

When the back-sight has been taken the legs are sent ahead in preparation for the next sight while the fore-sight is being taken. The dial is then removed to the set of legs which originally formed the fore-sight, and as these have been levelled with the cup the dial needs little adjusting, and the work is quickly performed. The back-sight cup is placed on the legs just vacated by the dial, and a bearing is taken to it. Meanwhile the man in charge of the fore-sight cup has taken it, together with the other set of legs, and is adjusting them for the next sight. In this manner the exact position of the stations are retained, and the work can be done accurately and expeditiously.

If three tripods are not obtainable, two may be employed to the same advantage regarding accuracy, but the work will take considerably longer to do, as no preparation can be made for the fore-sight until the back-sight has been taken.

In the event of only the one tripod being used, as in the ordinary method of loose-needle surveying, the sight lamp should be suspended from the roof, if practicable, by a cord, and the station should be marked with chalk. The usual surveyors mark is a dot with a ring or triangle round it. When the dial is brought ahead for the next sight it can be fixed fairly accurately under the mark by means of a plumb-bob. This method is not, however, so accurate as the former, nor can it be accomplished so quickly, but if it is a loose-needle survey with the exception of one or two sights it would be unpractical to carry three tripods during the whole period, and the latter method might be adopted.

Where the conditions of the seam require the angle of inclination, taking almost every sight to compensate for the measurements, the extra tripods will be found especially useful as the light is held about the same height above the floor of the seam as the sights of the dial, and thus the true inclination is obtained.

*(To be continued).*

## The Science and Art Department.

### *Important Alteration in the Mining Examination.*

We understand that the above department have at last come to the conclusion that it is necessary to give separate examination papers in each of the two branches of Coal and Metal Mining. They have occupied several years in finding out what has appeared a self-evident matter, but the committee are at last cognizant of that venerable motto, " It's never too late, &c. We must at last congratulate them upon their recovery from the blind state in which they have been for so many years, and take advantage of it. The details of the Coal Mining Examination, now organised, we hope to publish in an early issue.—Editor.

# COLLIERY MANAGER'S EXAMINATION QUESTIONS.

## *Newcastle District.*

JANUARY, 1893.

(FOR FIRST & SECOND CLASS CERTIFICATES.)

**No. 1 PAPER.**

*Time allowed—Four hours.*

The working out of all questions must be fully shown. No answer simply giving the result will be accepted.

(1) *Arithmetic.*—Add nineteen million nine hundred thousand and nineteen; one hundred and sixty million and six; ten million one thousand one hundred and one; three hundred and four million and forty thousand; ten million three hundred thousand and three.

Add three thousand six hundred and seventy-four acres one rood and ten perches to four hundred and twenty-five acres two roods and nineteen perches.

Subtract 6,784,329 from 11,222,333 (giving your answer in words).

Subtract eleven miles sixteen chains seventeen yards from twenty-four miles thirteen yards.

Multiply six pounds four shillings and five-pence-halfpenny by three thousand seven hundred and twenty-four.

Multiply ·065341 by ·00475.

Divide 617*l.* 8*s.* 7½*d.* by 234·5.

Divide the sum of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{3}{20}$ by the difference between $\frac{1}{3}$ and $\frac{1}{4}$.

(2) *Machinery.*—Describe, with sketches, the best examples of the following machinery with which you are acquainted, and give principal dimensions:—(1) Of a High Pressure Winding Engine. (2) Of a Condensing Pumping Engine. (3) Of a Boiler for High Pressure Steam (describing fittings and mountings necessary). (4) Ventilating Fan (and state its respective merits compared with other ventilating arrangements). (5) Of a Hauling Engine.

(3) *Pumping.*—Describe the action of lifting and forcing pumps, giving the terms used for all their parts.

A pumping engine goes seven strokes per minute, length of stroke 9 feet, diameter of pump 17 inches; what is the quantity of water pumped per minute in gallons?

(4) *Methods of working and ventilation.*—Sketch a district of bord and pillar workings for 20 hewers in a shift, and with the broken, following up the whole workings.

Sketch a longwall district for 36 hewers in a shift. In each case indicate the course of the ventilation by arrows, and show the position of all stoppings, regulators, and doors.

(5) *Timbering.*—Show, by plan and section, the method of timbering a 5½ yard bord with a bad roof.

Show, by plan and section, the method of timbering and pillaring (the face of a gateway and two adjoining gateways for a distance of 10 yards back) in longwall working.

(6) *Measurement of air.*—Describe fully two methods of measuring an air current.

State the velocity at which you would have air travelling through the workings.

The current of air in a drift, 8 feet by 7 feet 2 inches, is such that powder smoke passes along a distance of 60 yards in 14 seconds. What is the number of cubic feet of air passing per minute?

(7) *Safety-lamps.*—What description of safety-lamp are you familiar with?

Describe it with a sketch, and state the points wherein you consider it superior or inferior to other safety-lamps.

How many apertures per square inch has the gauze?

(8) *Explosives.*—Which explosive do you consider the safest for use in coal mines?

State your reasons, and explain what precautions you would take to prevent shots from blowing out.

(9) *Coal Mines Regulation Act.*—State the regulations—(1) As to stations and inspections. (2) As to circumstances under which notice to the Inspector is required to be given. (3) As to books and registers required (give a list). (4) As to hours of employment of boys, girls, and women. (5) As to shot firing.

*(To be continued.)*

(We are unable to publish the No. 2 Paper this issue through lack of space.—EDITOR.)

## COMPETITION QUESTIONS.

### No. 1 SET.

(See particulars of Gold Medal Competition on cover, commenced in this issue.)

TO the sender of the best set of Original Answers in each Stage will be awarded the following:—
**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best answer to each question will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."

2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3.—Correct name and postal address must be sent.

4.—They must reach us by November 2nd, 1894.

5.—The Editor's decision as to winners to be final.

#### ELEMENTARY.

*Question 1.*—What minerals are usually found together with coals? Which are valuable, and which are likely to injure it?

*Question 2.*—How is a mine on a lode laid out for working? Give sketch.

*Question 3.*—How can coal that is much mixed with shale be rendered fit for coking?

#### ADVANCED.

*Question 4.*—Describe the structural peculiarities of the Forest of Dean coalfield, and the difficulties encountered in working the mines. Give sketches if necessary.

*Question 5.*—How are the workings of mines represented on plans?

*Question 6.*—What are the special advantages and disadvantages of steam pumping engines placed underground?

#### FIRST-CLASS.

*Question 7.*—Describe, with suitable sketch, how you would arrange to guide the hoppit in a deep sinking shaft.

*Question 8.*—If a water gauge is placed on the separation doors at the bottom of a pit ventilated by fan, will it read more or less than one placed in the fan-drift, and why?

*Question 9.*—Is it necessary to maintain the ventilation of a mine when the pit is not working? Give reasons for reply.

*Question 10.*—Describe, with sketches, a method of automatically exchanging the tubs *in the* cage at the surface.

*(Answers to above will appear in No. 1, Vol. III.)*

## OUR GOLD MEDAL AND OTHER COMPETITIONS.

The appreciative manner in which our new scheme has been received, gives promise of a large and enthusiastic number of competitors. This is as it should be, as we are giving our readers an unprecedented offer. We are not charging two pounds for a course of lessons which can scarcely be excelled. The certificates will be of more value than those given at an ordinary examination, for the simple reason that the competitors will be put to a far more severe test; it is not from one set of questions that a result is arrived at, but from a series of twenty.

It has been suggested that it would enhance the worth of the scheme if we could arrange to let a student know how many marks he had obtained in any set of questions, and to criticise the answers where necessary. We have considered this point and have come to the following conclusion:—

***That a student who wishes to know the percentage of marks he has obtained, and to have his answers criticised in any set of questions, must enclose three stamps for postage, &c., and we will do as required.***

The following information is in answer to enquiries:—

1st.—If you have only obtained a second class in the advanced stage, you are eligible for that stage in our competition, and the same also applies to the elementary stage. If, however, you prefer entering for the first class you may do so.

2nd.—The essays may be sent in any time before the competition is closed. The length of each essay will depend upon the subject chosen by the competitor, but it should not exceed eight foolscap sheets ordinary writing—of course it may be much shorter.

3rd.—The winner of the prize in each stage may not necessarily be the one who obtains the largest number of awards. For example, if a competitor answers ten sets he gains the award in five, and the other five are poor sets, and another competitor with the same number of answers gains three awards and gives good papers in the other seven, the latter would be the most successful.

4th.—A student will gain marks for one or two questions even if the full set are not answered.

5th.—It is not essential that a competitor should answer every set, though the more the better.

6th.—No charge, either nominal or otherwise, will be made for the certificates.

## ROPE SPLICING.

THE following is a method of splicing ropes which I have adopted for five or six strand ropes, for a good number of years, during which time I have spliced a great number of ropes from one-half inch to one inch diameter. Have the tools necessary for the work in good order, as it is so much easier to work with them. The tools required are a hammer, chisel, and what I call "splicing pegs," two in number (see fig. 1). These are the only tools I use, and are quite sufficient.

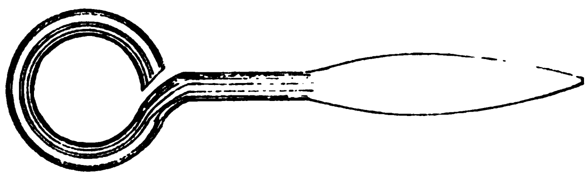


Fig. 1.

We will now take an example: say a rope of five strands requires splicing. Let A and B represent the ropes to be spliced (fig. 2).

The ends A and B must be pulled past each other a distance of ten feet (fig. 3). You now commence at A (fig. 3) and unlay the strands, taking two strands at a time to C. Now go back to A, and unlay the other strands in the same manner. This done, the rope is divided into three parts: two of the parts containing two strands each, the other of course being a single strand and the hemp core with it. This single strand always leave in the middle, and have it on the top. Then commence at B (fig. 3) and proceed in a similar manner to the side A. This done, you have the ropes as at fig. 4. Instead of putting the ends together now, with the three ends each ten feet in length, it is better to cut them in the following manner, because they are easier to handle and you are enabled to do the work much quicker.

I will now number the ends 1, 2 and 3 in rope A; and 4, 5 and 6 in rope B (fig. 4). These are numbered so that you can follow the explanation carefully. Take the ends No. 1 and 2, and cut off within eighteen inches of C, leaving end No. 3 the whole length, viz.:—ten feet. Perform a similar operation with the strands 4, 5 and 6. Then you have the ends as represented in fig. 5, and as such the ropes are now ready for putting together, but in doing so great care must be taken in placing the long and short ends so that you put them in their right places. You must now take hold of one rope and your assistant the other, and take care to put the ends 1 and 4, which are a long and a short one, side by side, and put end 4 over No. 1 end. Place the two single ends in the middle (Fig. 5). These are numbered 2 and 5, and if you are at the B end of the rope place No. 5 end on right of No. 2, and the ends 3 and 6 come side by side, which is a long and short end together. Of course this time the long end goes under the short one. After this is done you must pull the ropes together as tight as you can; then your assistant will grip with his hands the ends 5 and 6 and the rope A. These he will hold tight while you unlay the end No. 1, and at the same time the end No. 4 must be laid in the other's place. The rope will not be required to be held after you have laid several feet in length of No. 4 end in the place No. 1 end came out of. Unlay and lay these two ends until you have reached the half of the long end (five feet). Then unlay the strands separately, and here you interlock two of the ends and leave them while you take the other to, say, eighteen inches from the end. These are now inter-locked, and are ready for


Fig. 2

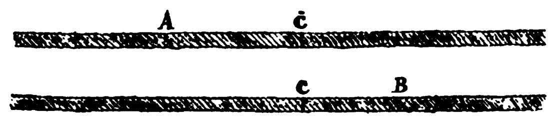



Fig. 3

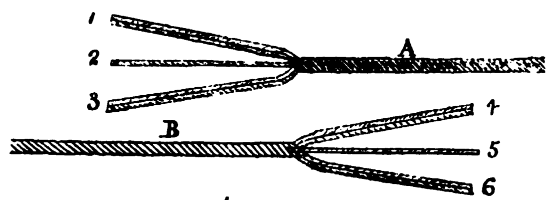



Fig. 4

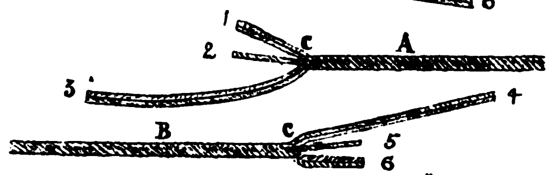



Fig. 5

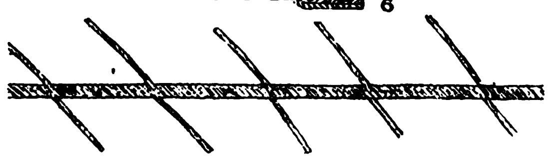


Fig. 6

running the ends in. The other side is done similar, and then those ends which are longer than is required are cut off, leaving them all about eighteen inches long as shewn in fig. 6, and as here represented the ends are all ready for running in after straightening them a little with your hands. Take the splicing peg and insert the point under the end intended to be run in, and push it in and under two other strands besides; then twist your peg on one side to open out the rope, so that your assistant can with the other peg pull out the hemp which runs in the middle of the rope. This hemp is cut off, and the assistant takes hold of it on the opposite side to your peg. Liberate this hemp for a couple of inches. Then take the end you want to run in and put it underneath your peg. Your assistant on the opposite side must put his peg through the same space as yours came out at, and push it under the end to be run in. Then take hold of his peg with the left hand, and hold it fast so that the rope will not twist round whilst the end is running in; with the peg in the right hand you must keep turning it round in the direction the peg has to be run in, and at the same time your assistant must pull out the hemp as you go along, because the end should embed itself, when run in properly, in the place of the hemp core. All the other ends must be done similarly. Rope splicing cannot be done neatly and quickly without practice.

*(To be continued.)*

# CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.

Envelopes to be marked "Correspondence."

Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

Correspondence must not be enclosed with Competition Answers.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

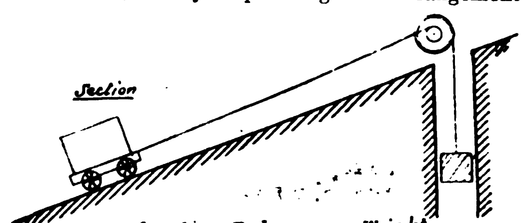
### The Proving of Faults. —Query.

Sir,—Would any of your numerous readers instruct me how to proceed with the following:—I have met with a step that takes all the coal out; the listing is perpendicular, neither shows for being an up-step or down-step. District unknown. "Westhoughton."

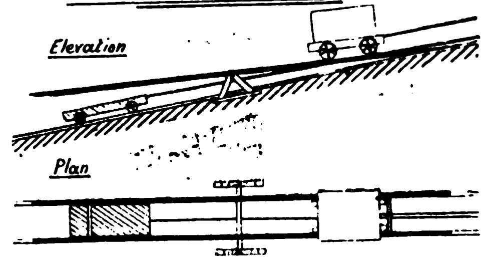
### A Self-acting Balance Brow. —Answers

Sir,—In reply to "Under Manager" in No. 22, Vol. II, I take it for granted that he has just one pair of rails upon it at present, so that he cannot make it self-acting without altering his rails a little. It can be altered in two ways, by having three rails along the length of the road and a double road at the meetings, or it may be left as a single road with the exception of the meetings, where a double road will be necessary. In this method, however, spring points must be fixed at the junctions so that the tubs will go on the right road. I hope this is what he wants, and if they are well laid at first he will find that they give very little trouble. "Aitchison."

Sir,—In answer to "Under Manager":—He may sink a shallow pit at the top of the incline, in which to allow a weight to ascend and descend. The weight should be suspended by a rope which coils on a drum whose axis is the same as the drum upon which the rope which is connected to the tub is coiled, but of a larger diameter, so that the pit may not be so deep.—See sketch. Or, he may adopt an ingenious arrangement




Self-acting Balance with Weight




Self-acting Balance with Pass-over

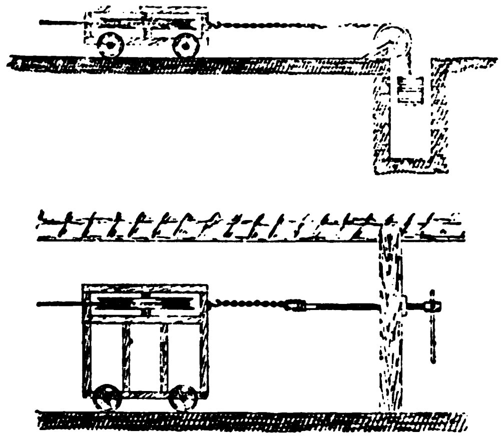
which has been successfully applied in South Wales. The balance consists of a long flat piece of iron fitted on wheels of the same gauge as the tub wheels. A rope is connected to the balance, passed round the return wheel at the top of the incline, and the other end is connected to the tub. Midway in the length of the road is placed a bridge of rails. A pair of rails of the same gauge as the road, about 25 feet long, are fitted so as to turn on a horizontal axis at the centre, the axis being about 18 inches above the road level. When the balance and the tub meet mid-way the balance passes under the axis while the tub runs on the elevated rails and passes over it. Immediately the tub passes the centre the bridge rails turn in the opposite direction, and the tub runs on to the proper road.—See sketches. T. R.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection.

# ENDLESS HAULAGE.

## Endless Rope System.

THE endless rope is undoubtedly the best system of haulage now employed underground. It adapts itself to almost any circumstances, and can deal with almost any quantity of coal. The endless method proper requires a double road, but in some cases a single road with pass-byes has been adopted. The tubs are attached to the rope in gangs or sets, and an attendant rides



Figs. 1 & 2.

with each gang. When the gang arrives at a pass-bye the attendant detaches it from the rope and waits until the gang coming in the opposite direction reaches the pass-bye, he then re-attaches the tubs to the rope and goes

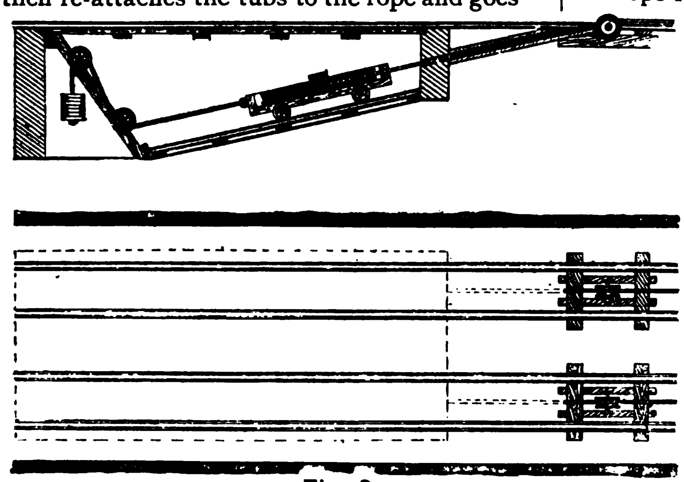


Fig. 3.

on. A single wagon road throughout is sometimes used, but in this case the rope moves backward and forward instead of moving continually in the one direction. This is a modification of the tail-rope, but whereas in the tail-rope method the rope requires to be three times the length of the haulage road, in the endless system a rope only twice the length of the haulage road is necessary. These methods are not so effective as the endless method proper, but a double road is found very difficult and expensive to keep open in some mines with a bad roof. When a double road is used, the arrangement is

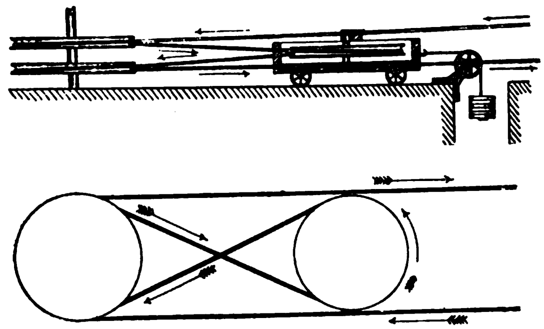


Fig. 4.

somewhat similar to the endless chain system, one road being used exclusively for full tubs and the other for empties; the rope always travelling in the same direction. There are two distinct methods of endless rope haulage which are known as Nos. 1 and 2 systems. In the No. 1 system the rope passes under the tubs, friction rollers being placed at intervals along the road, while in the No. 2 system the rope passes over the tubs. The rope receives its power from a single wheel, round which it is passed a few times to generate the necessary friction to prevent it slipping, or it may be taken round several wheels. It is necessary to keep the rope tight to prevent it slipping off the pulleys, and this is affected by passing the rope round a pulley fixed on a movable tram to which is attached a heavy weight,. which is suspended by a chain over a pulley, and thus the rope is kept tight. The tightening arrangement may be fixed at any end of the road. A screw is sometimes used instead of the weight, and as the load on a road seldom varies much, it is found to answer the purpose. Fig. 1 shews a tightening arrangement for the No. 1 system by a weight, and Fig. 2 shews a tightening arrangement for the No. 2 system. When the tightening wheel is at the [in-bye end of the plane, it is also used as the return sheave for the rope, and if

it is proposed to extend the road further, the return sheave or tightening pulley may be fixed under the level of the roadway (Fig. 3) so as to be out of the way. If the tightening

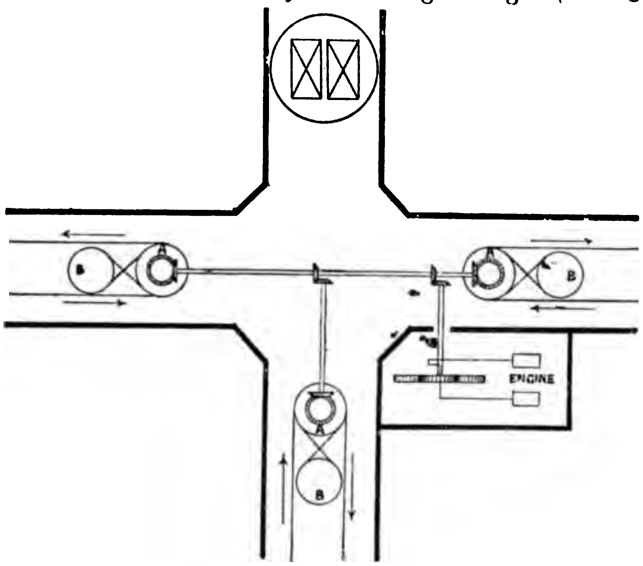



Fig. 5.

pulley is placed outbye it may be utilised to generate the necessary friction to prevent the rope slipping. Fig. 4 shews a suitable arrangement of these pulleys. There are two pulleys on the driving shaft, the rope is placed round one of these, then round the tightening pulley and back again round the other pulley. If these were thought to be insufficient to prevent slipping, the driving shaft might be fitted with three pulleys and the tightening arrangement with two. Both the driving and the tightening pulleys are placed under the wagon road, and the rope comes on to the road about 8 yards from the pulleys. Several roads can be worked in different directions from the pit by an arrangement of shafting and gearing (Fig. 5). A A are the driving wheels and B B the tightening pulleys. In the No. 2 system branches are worked in a similar manner as in the endless chain system, but in the No. 1 system the working of branches is not attempted. In the endless method of haulage branches can be worked only with difficulty and expense, though a branch road may be worked from the terminus of the main haulage road without much trouble either in the endless chain system or in the No. 2 rope system.

*(To be continued.)*

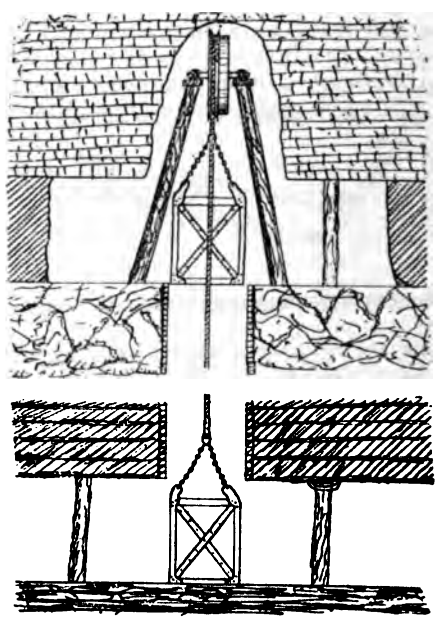
## ANSWERS TO QUESTIONS

### In No. 21, Vol. II.

#### ELEMENTARY.

*Question* 1.—How is the stuff drawn in small shafts underground not communicating with the surface? Give sketch.

*Answer.*—Small shafts underground are generally called "staples" in coal mining, or "winzes" in metal mining. A staple may be provided with two cages to hold one tub each and worked on the self-acting principle, the full cage in its descent pulling the empty cage up. The wheel, which must be the exact diameter as the distance between cages from centre to centre, is fixed at the top or head-gear something similar to an ordinary winding shaft, and is provided with a belt which is attached to a lever by means of a rod of iron to steady the cages while running, also to stop them when required. Both top and bottom are laid with flat-sheets so that the tubs can be moved about with ease. If of a good depth some kind of signalling should be adopted.



JOHN STEPHENSON.

*Question* 2.—What kinds of ropes are used in mines? Discuss their efficiency and the work to which each is applied.

*Answer*.—Generally speaking there are two kinds of ropes used in mines, viz., round and flat ropes. For winding arrangements either round or flat ropes may be used. For endless and main-and-tail rope systems of haulage round ropes are used. These ropes are generally made of iron, steel and hemp. In Belgium and France ropes made of aloe fibre are sometimes used. These ropes are a little stronger than hemp but much heavier, and absorb much more moisture than hemp. Round plough steel ropes are universally used in this country both for winding and haulage, being lighter, stronger and much more durable, especially for winding, than flat ropes. There are three varieties of round ropes in use:—(1) Those with the strands twisted uniformly in one direction; (2) Those with the strands twisted right and left; (3) Those having no strands but made of interlocking wires. The second class of ropes mentioned are often used in preference to flat ropes in sinking operations as the weight of the stitching employed in flat ropes adds very much to their weight. If flat ropes are used in winding they are coiled round a narrow drum, each coil overlapping the previous one. They consist simply of a number of round ropes sewn together. Flat ropes are heavy and expensive and liable to wear at the edges, and the wires with which they are stitched often wear away before the rope itself is worn out. Taper ropes have been suggested, and I believe tried, but the practical difficulty of making them with a taper with wires of a uniform diameter preclude their successful adoption. The duration of ropes, round or flat, will depend on circumstances. To ensure safety in the use and manufacture of ropes for winding or hauling the following precautions should be observed:–(1) They should be flexible; (2) The materials forming the strands should have an equal and uniform twist; (3) Elasticity in the material; (4) Tensible strength; (5) The construction of the rope should be such that the wires and strands are not disturbed when subject to full pressure; (6) To prevent ropes from breaking (winding) they should be examined and lubricated with non-corrosive oil or grease daily, in compliance with the C.M.R.A.; (7) A rope (winding or haulage) should be condemned when broken wires are observed; (8) No ropes should be taken from a larger to a smaller drum, because this plays havoc with the very best ropes.—JOHN HY. SENIOR.

*Question* 3.—What is ascensional ventilation?

*Answer*.—Ascensional ventilation is obtained by conducting the air in the first place direct to the lowest parts of the workings, and afterwards allowing it to rise as it returns to the upcast. The intake is always colder than the return, and by this system the return air is made to ascend and not descend. There is a loss of power effected by allowing the return air to descend to the bottom of the up-cast shaft. This is a practice which is, and should be, as much as possible avoided in well-managed mines. There is always a difference between the density of the intake and return air which is due to the change of temperature, the mixture of watery vapour, and the emission of gas, etc. The return air of any current is generally less dense than the current of the intake air on account of the change of temperature and the gases emitted being lighter than air. There is mostly a natural influence at work in favour of the intake current passing to the dip and returning by an ascending route and against the air, going first to the rise, and returning by a descending route. If we had a dip and rise current of air subject to the same ventilating pressure, in the case of the dip split there is to be added the pressure due to natural influences, and in the case of the rise split the pressure due to natural influences is to be deducted from the general ventilating pressure. This simple example, so repeatedly proved in practice, clearly shews us the value of ascensional ventilation, and the error committed of carrying the return air down the bank faces instead of allowing it to ascend. Suppose the return air to be charged with gases heavier than common air to such an extent as to make the return more dense than the intake air, results exactly opposite to the above mentioned would take place. This *supposition* is however an exceptional case, for as said before, the return air of mines is generally less dense in consequence of being higher in temperature, and impregnated with gases which are lighter than common air.

JOHN HY. SENIOR.

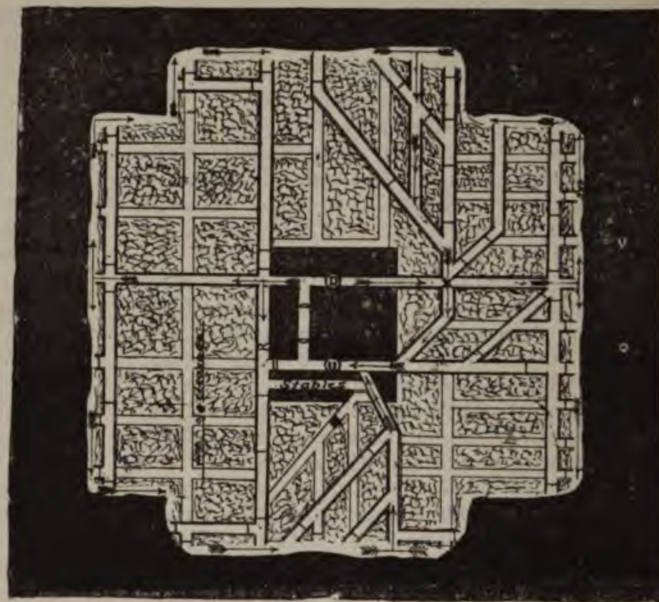
Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

**ADVANCED.**

*Question* 4.—Explain with sketch and show the ventilation of a method of longwall with which you are acquainted.

*Answer.*—The figure shows method of ventilating longwall workings. The air is carried up the middle gateway to the coal face, where it splits and travels right and left along the face of the longwall to the end of the district, and then goes direct into the return. This is a very simple arrangement, and needs few stoppings, doors, and brattices. The air has a short distance to travel, and there is a short length of rubbing surface producing a small amount of friction, and requiring little ventilative power. Gas given off at any point is carried along the face to the return. The gateways are ventilated by leakage of the air, and brattice should be kept about four feet from the ripping lip to remove all gas.

JABEZ MOORE.



REFERENCES:—
D—Down-cast U—Up-cast R—Regulator
‖—Stoppings D D—Doors | |—Cloths
Direction of current shewn by arrows
Roads in use shewn by dark lines

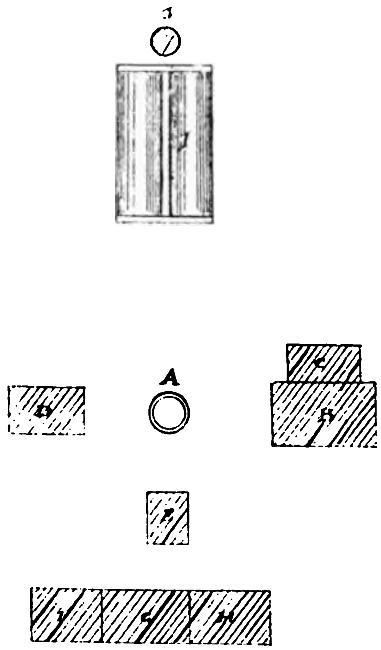
*Question* 5.—What are the conditions upon which you would advise working longwall and what are its advantages?

*Answer.*—The longwall method of working is often very successful where the thill or floor is sufficiently strong to bear the crushing force of the pack walls. It has been very successful in Lancashire for seams of two to five feet thick. At Wigan Junction Colliery they work a mine nine feet thick of cannel coal with a rock roof in longwall, and build stacks of timber filled in with dirt from the wastes to support the roof. The following are the conditions upon which I would work longwall system:—A seam free from faults which contains bands of dirt either top or bottom for holing in, and sufficient to build packs which our Arley, Yard, and other mines contain. In longwall working all the coal is worked away at once, leaving no pillars to crush. The advantages of longwall system are that a larger percentage of round coal is got and a less percentage of small. The system is simple, the ventilation easy, and a great saving of timber if properly looked after before it is broken. In the system of longwall working the proper position of the wall face depends chiefly upon the inclination of the seam. If the inclination is moderate the wall face should be at right angles to the dip of the seam. In this case the roads are easier to maintain. If the dip of the seam is considerable it is advisable to have the wall face parallel to the direction of the dip, and in this case the coal will be transported by cross-cuts worked by self-acting inclines. With a very tender roof the wall face should, if possible, be at right angles to the cleat or face of coal. With a good strong seam the wall face should be parallel to the cleat. I have known longwall worked in a zig-zag manner where the roof has been broken, and it acted well.

J. SMITH.

*Question* 6.—Describe with sketches the usual surface plant of a sinking pit.

*Answer.*—The usual surface plant of a sinking pit is shown in the sketch. Two small winding engines (if the sinking is not deep) are necessary, and are erected near the shaft on one side, and also a pumping engine to remove the water during sinking operations, if the quantity of water cannot be brought out with the kibble. Two boilers are erected at right angles to the shaft from engine house, as shown in sketch, and on the other side of the shaft is a steam capstan for raising and lowering bricking scaffold, pipes, tubbing, and anything which is a great weight. Behind this is




REFERENCES:—

A—Shaft B—Winding Engine C—Fan D—Pump
E—Capstan Engine F—Cabin G—Stores H—Smithy
I—Boilers J—Chimney

the stores, cabin and blacksmith's shop for sharpening tools for sinkers. The cabin is for the sinkers to change their clothing when wet. At the end of the cabin and at a safe distance is usually erected a store or magazine for powder, so that there should be no danger of large quantities of powder exploding with being too near to the surface fires.

HERBERT HALL.

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### FIRST-CLASS.

*Question* 7.—If a heavy fall occurred which entombed several men, how would you proceed to liberate them?

*Answer.*—If a heavy fall occurred which entombed several workmen the process of liberation would greatly depend on the conditions presenting themselves, so that the position of the entombed men should be ascertained, and a road cleared into them by fitting up a set of timbers and driving piles over the top with their ends projecting upwards into the fall; then removing away the stuff beneath them, and at the same time fitting up sets of timber under the piles as you proceed until their ends are nearly reached, when a second set will have to be driven underneath the first with their ends also projecting upwards, and so on until the refuse has been cleared away to such an extent as will suffice to allow the removal of the victims to the fall. If access can be obtained to the other side of the fall then a set of workmen should be put to work in the same manner, in order to penetrate the fall and further assist operations. In such a case great excitement will prevail, even with the strongest-hearted workmen, and great caution should be taken in proceeding so as to go about the work in a sharp but careful manner, as large falls generally allow a free exit to a large quantity of gas from the strata above. Therefore, safety lamps should be used, and a good current of air directed to it to remove such gas and keep the mine in a healthy state.

JOHN McPHAIL.

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*Question* 8.—How many gallons of water will a pump of the following dimensions throw in twelve hours, allowing 10 % for loss. Diameter of pump, 18 inches; length of stroke, 8 feet; number of strokes per minute, 8?

*Answer.*—The quantity of water a pump will throw in a given time may be determined by multiplying the decimal area of pump by length of stroke in inches; again by number of strokes per minute, dividing the total by number of cubic inches in a gallon, minus ten per cent. for leakage, and again multiplying by number of minutes in a hour, and by number of hours.

$$18^2 \times \cdot 7854 \times 96 \times 8 =$$

$$\frac{195432 \cdot 6528 \text{ cubic inches per minute}}{276 \cdot 48 \text{ cubic inches in a gallon}} =$$

$706 \cdot 86 - 70 \cdot 68 \times 636 \cdot 18$ gallons per minute.
$636 \cdot 18 \times 60 \times 12 = 458049 \cdot 6$ gallons thrown by pump in twelve hours.

Or, the quantity may be determined by using a constant $18 \times 18 \times 8 \times 8 \times \cdot 034 =$ 705 gallons per minute, minus 10 per cent. $705 - 70 \cdot 5 = 634 \cdot 5 \times 60 \times 12 =$ 458040 gallons pumped in twelve hours.

GEO. COLLINS.

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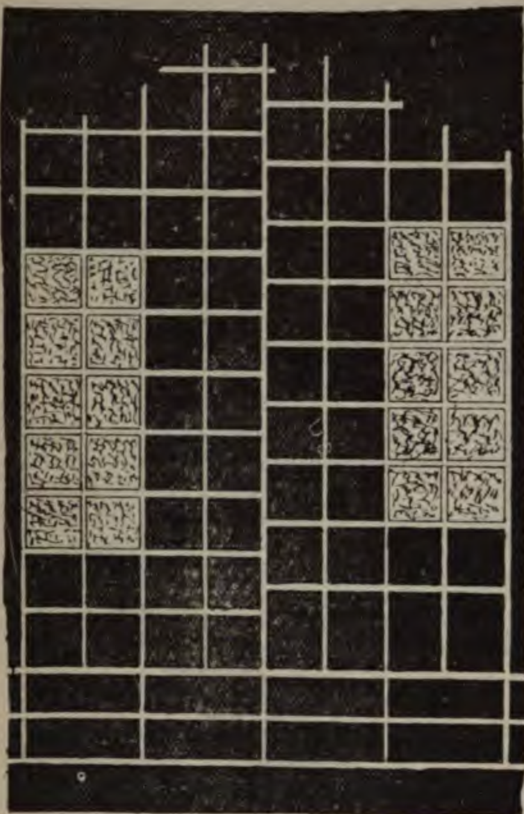
*Question* 9.—Sketch and describe what you consider to be the best method of working to the rise a "fiery" seam of coal 5 feet thick, dipping 1 in 7, with the following section of roof and floor:—

ROOF—Strong cliff, 4ft. FLOOR—Fireclay, 1ft.
Clod, 1ft. Hard cliff, 2ft.

*Answer.*—The accompanying sketch of stoop and room working shews the method I consider the best for a seam with such height, character and section. Three main roads are driven level course from the shaft, ten yards apart, and from these, headings are set off to



the rise, and 200 yards in breadth, with ten yards of a barrier of coal between each of these districts. The main roads should be driven eight feet wide, except in cases of necessity of landings or stations being required, and the bords turned twelve feet wide, which is a fair width under such conditions. The size of pillars or stoops will depend on the depth from the surface, but as the floor is soft a good size of pillar will be required to prevent heaving, so that they may be left from thirty to forty yards square. The roads may be brushed by ripping down the one foot of clod, and lifting the thickness of fireclay. Then, as it is highly inclined, the whole should be followed up with the broken, *i.e.*, to remove the stoops as the workings proceed by commencing two to three stoops from the main roads and keeping about four pillars length from the working face, as otherwise the weight of the strata above would be thrown on the pillars, and consequently crush them into small before being removed. The sketch shews one district, which I think will serve to make the answer clear.

JOHN MCPHAIL.

*Question* 10.—State what gradients with or against the load you would prefer for endless rope and main and tail rope haulage, and give your reasons?

*Answer.*—In endless rope haulage the gradient should be with the load, and just sufficient to balance the empty tubs on the other road passing in-bye, so that the engine would just require to overcome the friction required to keep the tubs in motion, therefore a fall to the shaft of about one inch to the yard would suffice. The main-and-tail rope haulage system is adopted when the gradient in-bye is insufficient to make the tubs self-acting, or when the gradient out-bye is insufficient to allow the empty tubs to draw the rope behind them from a direct hauling engine. In this system the horse-power has to be calculated on the heaviest portion of the road, therefore a road having such a fall to the shaft as will bring the power of hauling out-bye the full tubs to be equal to that required to haul the empties in-bye would be the gradient preferable for such a system, but, in my opinion, the main-and-tail rope system is most advantageous on a level road.

JOHN MCPHAIL.

## AWARDS

FOR ANSWERS TO QUESTIONS IN THIS ISSUE.

ELEMENTARY.—John Hy. Senior, 16, Thompson Row, High Street, Rawmarsh.

*Commended.*—J. Stephenson.

ADVANCED.—Herbert Hall, 15, Yardley Row, Ryhill, Wakefield.

*Commended.*—J. Smith, J. Moore, T. Lawrenson, T. E. Aitchison, J. King, Hy. Talbot, S. Davis, G. Daykin, T. Walker.

FIRST-CLASS.—J. McPhail, 6, Sourlie, Irvine, Ayr.

*Commended.*—J. N. Wardell, G. Collins, G. Dixon, S. Thorpe.

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—Invention, Universal Index, Technical World; also W. Shedden, Hopkinson, J. Brettel, Wm. Finlay.

ANXIOUS TO KNOW.—Particulars next issue.

R.F.—The best education course you can adopt is to join the competitions now commencing in our journal.

STUDENT & OTHERS.—See remarks on Gold Medal Competition.

THOMAS SMITH, KIBBLESWORTH.—We will continue the Answers to Exam. Questions early next volume, and will try to accede to your request. Write again later on.

JOHN FOX.—Glad to hear our paper has helped you. Try for the other prizes, as we shall no doubt offer another Medal after this competition closes, when we hope you will have improved.

*Printed and Published by* STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MINI

No 25. Vol. II. SATURDAY, NOVEMBER 3, 1894. FORTNIGHTLY. ONE PENNY.


## CONTENTS



# EXPLOSIVES.

## Important Experiments at Wigan.

THE Managing Director (Mr. BENEKÉ) of a syndicate formed to introduce a recent explosive "Westphalite" into this country made arrangements for a series of tests on various explosives, to take place last week, at an experimental station laid down at Messrs. PEARSON & KNOWLES' Moss Colliery, Ince, near Wigan. The experiments were witnessed by a number of Government mining inspectors, mining engineers, and colliery managers. The experiments were in charge of Herr BRINKAUS, from the manufactory, Germany, and were conducted by Mr. HIGSON, mining engineer, and Mr. BENEKÉ. As a guarantee that the conditions of the tests were strictly and correctly carried out, a committee consisting of Messrs. D. H. MATHEWS (inspector of mines), J. ISHERWOOD, J.P. (miners' agent), and J. S. BURROWS (mining engineer), was appointed to superintend the weighing of the explosives and to record the results of the experiments. The experiments were carried out in a testing apparatus consisting of an iron boiler 30-ft. long and 5-ft. 10-in. diameter, placed in a horizontal position, with a cast-steel mortar fixed in the far end, this part of the boiler being so arranged that a portion could be shut off by a division into an air-tight compartment of 225 cu. ft. in which a specified quantity of coal dust or gas could be introduced. The explosive to be tested was placed in an ordinary cartridge in the steel mortar, and fired by electricity in such a manner as to represent, as nearly as possible, a blown-out shot going directly into the division of the boiler containing the coal-dust or the explosive mixture.

The results of the experiments as reported by the committee were as follows:—

EXPERIMENTS WITH COAL-DUST.

($\frac{1}{2}$ cu. ft. of coal-dust.)

| Explosive. | Result. |
|---|---|
| Dynamite, Roburite, Tonite, Bellite, Ammonite | Complete ignition of the coal-dust, large flame and explosion. |
| Westphalite | No ignition, no flame, no explosion. |
| Ardeer Powder, Carbonite | No flame, no explosion. |

EXPERIMENTS WITH EXPLOSIVE MIXTURE OF COAL-DUST AND GAS.

($\frac{1}{4}$ cu ft. of coal-dust and 5% of coal gas.)

| Explosive. | Result. |
|---|---|
| Carbonite, Ardeer Powder, Westphalite | No flame and no explosion. |
| Roburite | Explosion and flame, apparently of gas only. |

EXPERIMENTS TO TEST RELATIVE STRENGTHS.

A projectile 35-lb. weight was fired at an elevation of 55 deg. from a mortar charged with a ten-gram (=⅓-oz.) charge of each explosive. Detonator, No. 6.

| Explosive. | Distance projectile was thrown. |
|---|---|
| Dynamite | 188 yards |
| Roburite | 182 ,, |
| Westphalite | 177 ,, |
| Bellite | 171 ,, |
| Ammonite | 163 ,, |
| Tonite | 111 ,, |
| Carbonite | 77 ,, |
| Ardeer Powder | 61 ,, |

The general opinion expressed after the conclusion of the experiments was that Westphalite, under the conditions of the tests carried out, proved to be decidedly the safest explosive for mining purposes, but it was strongly urged that further experimental tests should be carried out with the numerous flameless explosives that have recently been introduced, of an independent and official character, with a view of still more satisfactorily testing their respective safety.

The special advantages of Westphalite are said to be as follows:—

(1) Absolute safety from explosion of fire-damp and of coal dust.

(2) Innocuousness of the explosive gases.

(3) Great uniformity in the quality of the explosive.

(4) Absence of all danger in the manufacture and handling of this explosive.

(5) It is not affected by cold or heat, or by hammering or other rough usage.

(6) Development above that of Kieselguhr dynamite though less locally shattering, and consequently producing the largest percentage of round coal.

(7) Cheaper than any other explosive.

(8) Contains no nitro-gelatine.

(9) Owing to its safety from all risks of explosion it can be transported on German railways.

The Government of Saxony who for many years prohibited the use of any kind of explosives, on account of the dangerous nature of the coal mines, have made one exception in favour of Westphalite. The Prussian Government collieries in connection with the State railways also use Westphalite in their pits.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience *and annoyance* will be avoided.

## COMPETITION QUESTIONS.

### No. 2 SET.

(See particulars of Gold Medal Competition on cover, commenced in this issue.)

To the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best answer to each question will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."

2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.

3.—Correct name and postal address must be sent.

4.—They must reach us by November 16th, 1894.

5.—The Editor's decision as to winners to be final.

#### ELEMENTARY.

*Question 1.*—Give a detailed account of how you would search for coal in an unknown district. Describe the instruments you would use (if any), to find the probable direction, rate of the dip, etc. Give sketches, if necessary.

#### ADVANCED.

*Question 2.*—Describe the principle and use of the thermometer, barometer, anemometer, and water gauge.

*Question 3.*—Describe what you consider to be one of the best type of safety lamps.

#### FIRST-CLASS.

*Question 4.*—What are the advantages and disadvantages of a forcing fan?

*Question 5.*—Describe and illustrate how you would put in stoppings, and what material you would use, where the drifts are 15 feet wide and 8 feet high. Show how you would brattice a heading 9 feet wide in the face of which there are large feeders of gas.

*Question 6.*—Explain the principle of a safety lamp, and say whether it is more likely to pass flame through a gauze with a large flame or a small one when it is put into an explosive mixture. Give reasons for your answer.

# ENDLESS HAULAGE.

## ENDLESS ROPE SYSTEM.—(Contd.)

### Transmitting Power from Surface.

If the engine be situated at the surface, which is, as previously stated, the better position, the power may be transmitted underground, as shown in fig. 6. An endless rope is passed one-and-a-half times round the wheel A, which is driven by the engine, and passes over one of a pair of pulleys (B) placed at the top of the shaft, and from thence down the shaft, round one of the pulleys C, again round the tightening pulley E to the pulley D, round which it is passed a few times, and back again up the shaft to the driving wheel. The rope in the shaft may be covered with wooden pipes, but this is not always deemed necessary. If it is in an up-cast shaft, however, it is better to do so, to protect the rope.

One or more pulleys are placed on the same shaft as D, according to the number of roads to be worked. In the figure only one road is shown as being worked by the wheel F, but any number of roads may be worked by simply increasing the number of wheels on the driving shaft. These wheels are each fitted with a clutch arrangement for stopping the haulage rope at any time without having to stop the main driving rope from the surface.

The tightening wheel shown in the figure simpls acts for the main driving rope, and a separate tightening arrangement must be fitted up for each haulage rope. In the overhead, or No. 2 system, the tightening wheels are usually placed at the in-bye end of the road, as it is not always convenient to place it near the shaft. The correct position for the tightening arrangement is at the lower end of the haulage plane whichever that may be.

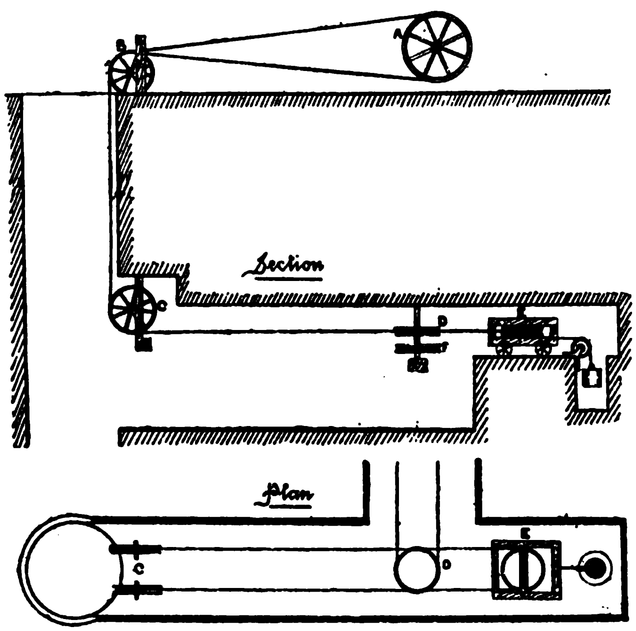



Fig. 6.

When only one road is being worked underground the one rope is sometimes used to transmit the power from the surface and to work the haulage plane. Under these circumstances, if the haulage road is of considerable length, a tightening wheel placed at the in-bye end of the plane will be found sufficient to keep the rope tight. Sometimes, however, another tightening wheel is placed near the shaft bottom to keep the rope in the shaft tight. The usual arrangement consists of a vertical weighted pulley which slides up and down between guides, thus accomodating itself to the rope.

An advantage of having the engine on the surface for endless rope haulage is that two or more roads can be worked at different depths in the same shaft, and in fact the one engine can be employed to work the whole of the haulage roads about the colliery.

### Modes of Attachment to Rope.

Numerous methods of attaching the tubs to the haulage rope are employed. In the No. 1 system in which the rope runs under the tubs the mode of attachment is usually by means of clips which are connected to the tub and firmly clamp the rope. Sometimes, however, the rope is fitted with sockets at regular intervals, and attachment is made by a short chain. The tubs are usually attached in this system in gangs or trains, a bogie being provided at the front end of each, in which an attendant rides, and clips the rope as required. Figs. 7 and 8 show an elaborate arrangement of bogie and equipments as employed in some of the American mines, where the roads are in good condition, and very extensive. We doubt if anything so complete is adopted in any of the mines in this country.

HANSON'S haulage clip is a very good one, and is made in two sizes: one being suitable for bogies, and the other for attaching trains or single tubs. Fig. 9 shows the mode of attaching the bogie clip. In the bogie there

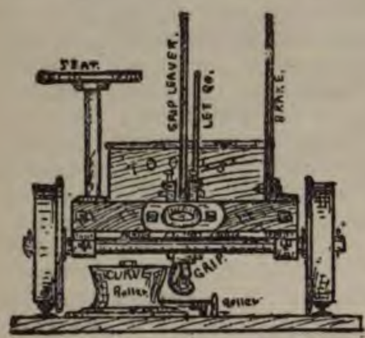



Fig. 7.

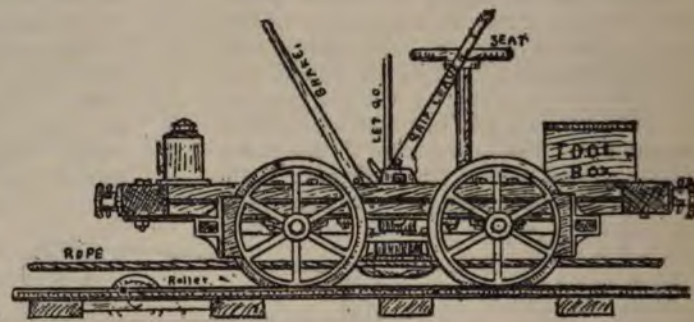



Fig. 8.

are two fixed bars of wrought iron (B and D) twelve inches apart, and the clip being nine inches on the clipping or gripping part, gives three inches of space for the clip to move from one bar (B) to the other (D). The clip is suspended on a one-inch round iron bolt or pin (A), and as the gradient of the road alters the whole clip will slide backwards and forwards upon the bolt or pin till it comes in contact with one of the bars B or D. In the illustration the clip is represented to be drawing or shunting a load up an incline or on the level in the direction of the arrow, and it will be noticed that the greater the load, or greater the resistance the tighter the incline block will be forced upon the rope. Now, should the gradient of the road alter to a descent, the resistance being taken off the bar in the bogie at B, the tendency of the load will be to go at a greater speed, thus causing the clip to slide back upon the bolt or pin at A till it arrives at the bar D in the bogie, and *dotted line A to D*, thus preventing the load *overtaking the speed* of the rope—in fact, it

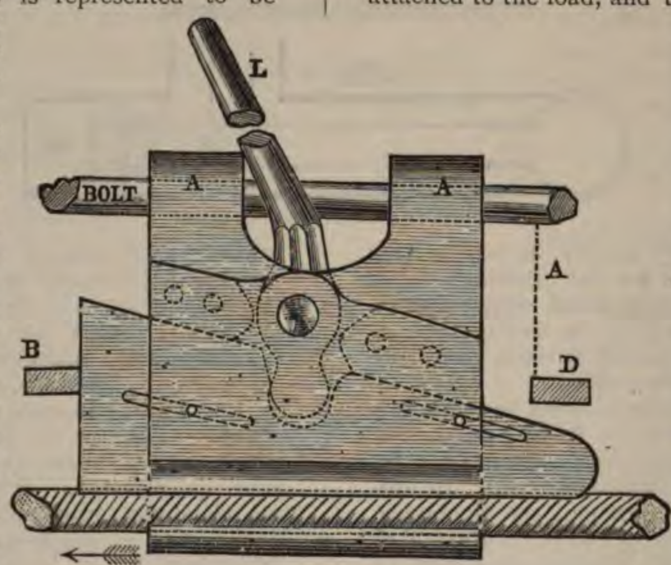



Fig. 9.

holds it back. The bar D pushing against the body of the clip gives the same tendency to force the wedge upon the rope as when the bar B was on the wedge. The operator lifts the rope into the groove at the lower part of the plate and brings down at his leisure the incline block by means of the level (L) which block grips the rope, the load being at once set in motion. The bolt or pin acting as a centre for the clip to rotate upon can thus be moved at the will of the operator.

HANSON'S train or hand clip is shown by fig. 10, in which the mode of attaching will be seen. The hook of the clip is attached to the load, and the lever is moved back towards the load, which motion raises the inclined block. The clip being now open is placed upon the rope, when the lever is moved sharply from the load thus causing the inclined block to be brought down, which grips the rope and thus moves the load. The clipping part being seven inches long the rope is not damaged or cut in any way, and, as with the bogie clip, the greater the load the tighter it grips. It is not liable to get out of order, can be instantly dis-engaged, and can be

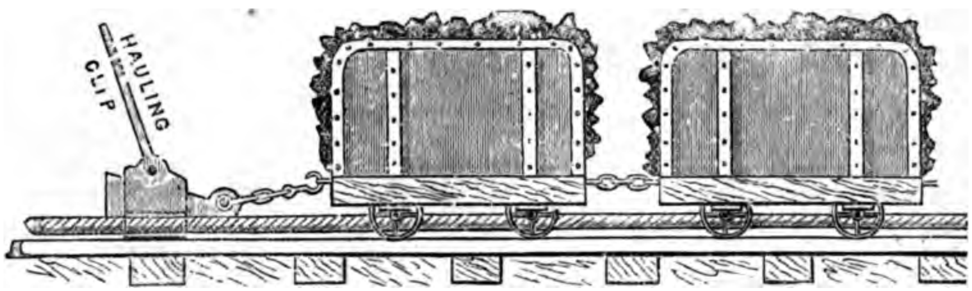



Fig. 10.

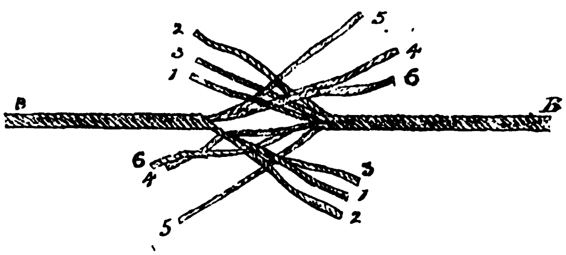
managed by a boy. It adapts itself freely to curves, the lower part being made to suit the groove of the pulleys.

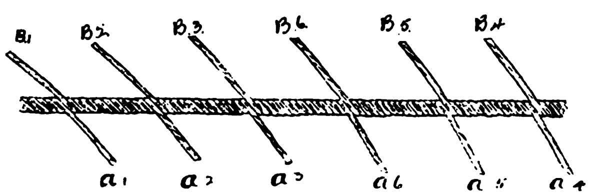
(*To be continued.*)

## ROPE SPLICING.

*Continued from last issue.*

ANOTHER method of splicing ropes and one that is recommended by W. B. Brown & Co., Wire Rope Manufacturers, Liverpool, is as follows:—That the splice should be from twenty-five to fifty feet in length, and the mode of procedure as follows: Measure off 30 feet from the ends of the two ropes that have to be spliced, open out the strands (singly) of A rope between those of B rope as per sketch. Great



care must be taken that the strands from each rope pass or cross each other in regular succession. After these are all crossed then pull the ropes tightly together so that the cut out cores may abut against each other; for ease and convenience the alternate strands in each rope may now be cut off five feet from the juncture, this will facilitate the after work. The next process is to take strand No. 1 of A rope, and as it is being unlaid, follow it up with strand No. 1 of B rope. which must be laid in its place firmly and tightly until within five feet from the end, Strand No. 1 of A rope is then cut off leaving it five feet long the same length as No. 1 B strand. Then take strand No. 2 of A rope which unlay and follow up with strand No. 2 B rope and so on with all the others. The strands being now all laid in their places the ends are cut off as with the first strands to five feet in length, the splice will then present the same appearance as sketch. The next operation is to tack in or insert the ends for core, the first part of which is to cut the rope core where strands A1 and B1 meet, then pull out the hemp core three or four inches, when this is done take a pair of tongs specially prepared for this purpose, and press the strand into centre of rope; when the core has been withdrawn the remainder of strand will follow in its place, it being assisted by means of one or two prickers inserted through one or two strands of the rope which partly opens these, and by following the withdrawn core the strand readily takes its place; when A1 is thus disposed of follow the same course with B1, and so on with the ten remaining strands. (This is for a six strand rope which leaves you twelve ends to run in and ten for a rope of five strands.) It greatly assists the holding of the splices to lap six inches or so of the end of each strand with small annealed wire, say 18 or 19 B.W.G. before beginning to tack in the ends, this not only keeps the strands from opening out but causes the outside strands to grip the inlaid one firmly and give greater holding capacity.

(We will give a few notes and observations respecting wire ropes—round and flat—for winding purposes in next issue.)—Ed.

# COLLIERY MANAGER'S EXAMINATION QUESTIONS.

## *Newcastle District.*

JANUARY, 1893.

(FOR FIRST & SECOND CLASS CERTIFICATES.)

**No. 2 PAPER.**

*Time allowed—Four hours.*

The working out of all questions must be fully shown. No answer simply giving the result will be accepted.

### FIRST CLASS.

(1) *Sinking.*—Describe the method of sinking a shaft where quicksand is met with in the first 30 fathoms.

Give sketches and dimensions of the materials generally used while sinking through quicksand for a pit intended to be 12 feet diameter when finished.

(2) *Surface arrangements.*—Make a sketch showing the surface arrangements you consider necessary for a colliery having an output of 500 tons per day, and where there is pumping and ventilating machinery.

(3) *Underground arrangements.*—Draw a plan, showing how you would lay out the workings of a colliery for 125 hewers in each shift.

Give the number of men in each district.

State the quantity of air in each split, and indicate its course by arrows.

Show the position of all stoppings, crossings, doors and regulators.

Show main ways and landings.

NOTE.—One-half the output to be from bords and pillars, and one-half from long-wall workings.

(4) *Gases.*—What gases are met with in coal mines?

Give an account of their nature and properties.

Supposing a level drift, 70 yards long, to be filled with fire-damp at the most explosive point, and that the air and gas could be separated, what length of the drift would each occupy?

What amount of atmospheric air would render the above mixture non-explosive?

(5) *Ventilation.*—Explain the theory of the ventilation of mines, and why artificial ventilation is more reliable than natural.

Explain the rule which should be followed in splitting the air, and state what is the practical limit to the number of splits, and why?

How should a deputy or other responsible official proceed to remove an accumulation of fire-damp in a working place?

Should such official report the condition of the place as he found it or as he left it?

(6) *Furnace.*—Sketch a furnace, suitable for 100,000 cubic feet of air per minute, giving its dimensions and relative position to the shaft.

(7) *Barometer and thermometer.*—Explain the use of the barometer and thermometer.

How would you expect the gases in a mine to be affected by a fall or rise of the barometer?

How does a change in the atmosphere, indicated by the thermometer, affect the condition of a mine?

(8) *Haulage.*—Describe, with sketches, any system of mechanical haulage with which you are familiar.

Describe the method of working it.

Explain fully the method of attaching and detaching tubs at the several landings and other places where necessary.

Describe the method of working curves and junctions.

(9) *Dams.*—What precautions are necessary in selecting the position and preparing the place for a dam capable of resisting a pressure of from 50 to 100 fathoms of water?

Sketch two such dams (giving the dimensions), one of timber and one of brickwork, for a place 6 feet high and 8 feet wide.

What is the pressure, in lbs. per square inch, due to a vertical column of water 75 fathoms in length?

(10) *Surveying and levelling.*—Describe the ordinary method of surveying, and the instruments employed.

In using the magnetic needle, what precautions have you to take in surveying and plotting?

Plot the following bearings, and state what should be the course and length of the seventh set, to tie with the beginning of the first set.

| No. | | Links. |
|---|---|---|
| 1 | S 47¼ E. | 340 |
| 2 | S 79½ W. | 160 |
| 3 | S 30¾ E. | 420 |
| 4 | N 62½ W. | 710 |
| 5 | N 41 E. | 230 |
| 6 | N 62½ W. | 340 |

Describe the systems of levelling you are acquainted with, and show how to keep a level book, and reduce the levels.

*(To be continued).*

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

## ANSWERS TO QUESTIONS
**In No. 22, Vol. 2.**

### ELEMENTARY.

*Question* 1.—What is atmospheric air. Is there any variation of this air. If so, how does it affect the ventilation of mines?

*Answer*.—WHAT IS ATMOSPHERIC AIR? It is a sea or layer of certain gases which encircle the earth. The pressure caused by the weight of the atmospheric air is nearly 15 lbs. per square foot at the sea level, and increases in weight as we go lower, and decreases as we go higher. The atmosphere is essentially a mixture of two gases—oxygen and nitrogen, nearly in proportion of one volume of oxygen to four volumes of nitrogen. These gases are simply mixed, and not chemically combined. Other gases exist in small quantities. Its average composition is:—

| | |
|---|---|
| Nitrogen ....... | 78·09 |
| Oxygen ...... | 20·53 |
| Water ........ | 1·34 |
| Carbon Dioxide | ·04 |
| | 100·00 with traces of other gases. |

IS THERE ANY VARIATION OF THIS AIR? The atmospheric air is continually changing from day to day. When the days are warm the air is much lighter than on cold and foggy days when it is much more dense or heavier. These frequent changes of atmospheric air are duly recorded to us by the barometer rising or falling as the pressure increases or decreases.

IF SO, HOW DOES IT AFFECT THE VENTILATION OF MINES? The affect of the variation of the atmospheric air is most clearly shown where the ventilation is natural. Natural ventilation is produced by having two shafts, one shaft being much deeper than the other. The difference in depth of the two shafts will, of course, produce a difference of pressure, and create a current to be set in motion. The direction of the air will be to the shaft of least resistance. This will of course depend upon changes of the atmosphere. Thus on a hot day the deeper shaft would be the downcast for the following reasons:—The air in the deeper shaft would be of the same temperature as the strata, which on hot days is much lower than the temperature of air, and hence would be much heavier than the air in the shallow shaft, or in other words, to the shaft of least resistance. On cold days results exactly opposite to the above mentioned would take place. The atmospheric changes, as shown by the barometer, have a considerable effect upon the liberation of fire-damp. A rise in the barometer shows an increase of pressure which will keep gases back, while a fall in the barometer indicates a reduced pressure which will allow the gases to issue more freely from the coal, goaves and fissures in the mine.—JOHN HY. SENIOR.

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*Question* 2.—Describe with sketches how you would secure the main haulage roads near the shaft of a mine whose output is expected to be large?

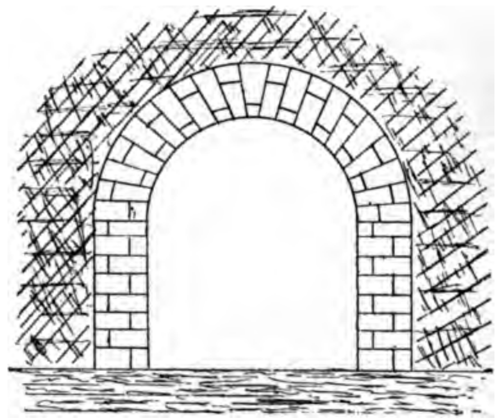

FIG. 1.

*Answer*.—In this case the roads will have to be of a good width so as to allow of a double way, or perhaps three ways, being laid with sufficient room between each way so that the persons employed at the shaft bottom can move freely between the tubs which may be standing on the said ways. Timber is very expensive, as the wood soon decays and is

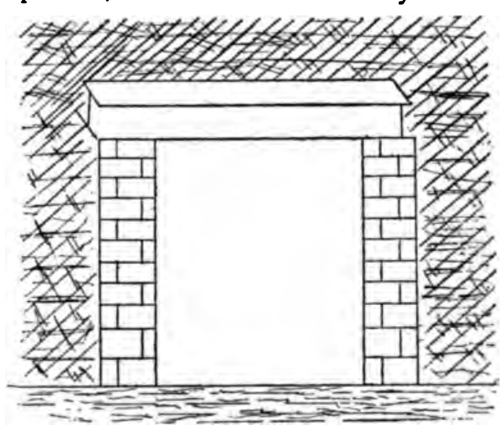

FIG. 2.

readily destroyed, causing additional expense by replacing new timber. Therefore, I consider one of the best methods is to

construct an arch with brick or stone (brick being mostly employed) as in fig. 1, all the bricks radiating from the centre. Thus, with a medium pressure on the arch the bricks are tightened and the roof made secure. This is the popular method, and about the cheapest and safest of all. Another good method is to build up a vertical wall of brick on both sides of the road for the reception of iron or steel girders (fig. 2) which span the road, the ends being secured on the above-mentioned walls. This method will do very well where there is a good hard roof, but in case of a soft roof a good arching is preferred.—JNO. STEPHENSON.

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*Question* 3.—Name the two gases generally met with in coal mining, and state how they are detected and the results of their presence in the workings?

*Answer*.—The two gases usually met with in mining are:—(1) Light Carburretted Hydrogen, otherwise known as fire-damp, marsh gas, and merthyl hydride. It consists of one part of carbon united with four parts of hydrogen. Its symbol is $CH^4$. It is a very light gas being little more than half the weight of air, its atomic weight being 8· Taking the specific gravity of air to be 1,000, that of fire-damp is 559, or it may be 1·0, and ·559. Owing to its lightness this gas when given off is always found in the highest parts, or next the roof. It accumulates in the goaves which are difficult to ventilate, and expands and shows itself at the goaf edge upon a decrease of atmospheric pressure. Its presence may be detected by the effect it has on the flame of the safety lamp. If in a small percentage of gas to air it causes the flame to thicken, but if more gas be added the flame will be surmounted by a blue cap, and if still more gas be added it will cause an explosion inside the safety lamp. Its presence in the workings is of a dangerous nature owing to its being of such a highly explosive mixture, and no other but a thoroughly experienced man should test gas.

(2) Carbon Dioxide, otherwise known as carbonic acid, black damp, stythe, and choke damp. It is composed of one atom of carbon united with two atoms of oxygen. Its symbol is $CO^2$, and is a very heavy gas, its atomic weight being 22. The specific gravity of air being taken as 1·000, that of stythe is 1·529. It may be found in dip workings, and its presence detected by the effect it has on the flame of the candle or safety lamp. If there is a small percentage of stythe to air it diminishes the flame, and by adding more stythe extinguishes the flame, and is fatal to breathe.— GEO. TWEDDELL.

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### ADVANCED.

*Question* 4.—How should a down brow place giving off black-damp freely, be ventilated?

*Answer*.—Black damp or carbonic acid, $CO^2$, density, 22; and specific gravity, 1·529. This gas has other names such as stythe, choke damp, but the proper name of it is carbon dioxide. It is a very heavy gas, and is always found stratifying near the floor or pavement, or is found in the lowest points of any working place; it is also found on the bottom of roads, wells, and sinking pits, like water with air circulating on the top. It is very difficult to remove out of any dip place. The best plan to remove such a dangerous gas as $CO^2$ is to divide the down-brow by a bratticed brick walling built from the floor to the roof, technically called an "intake" and "return," having a small hand fan in a refuge hole in the in-going or in-take side, and a strong boy in charge of it during the shift, so as to keep the working face clear while the workmen are at work, as well as removing the gas before they commence their day's labour. As the working face of this down or dip brow is advancing the walling needs advancing as well, and the hand fan can be removed at will any time, with very little trouble, if the down-brow is to be driven several hundred yards. This is one of the best cheapest and most economical methods to ventilate such a place. To expedite the drivage of this brow I would suggest the following, if there are any compressed air engines about the mines, then the compressed air should be conducted to the place by a line of pipes laid on the floor of the wide side and carried as near to the face as practicable. This will aid the little fan, keep the place pure, and remove both gas and all smoke from explosives, if any are used. By this mode we managed successfully to carry on a down-brow (single-place) for a distance of nearly 200 yards, giving off large quantities of black-damp, and four men working per shift.—

SAMUEL DAVIES.

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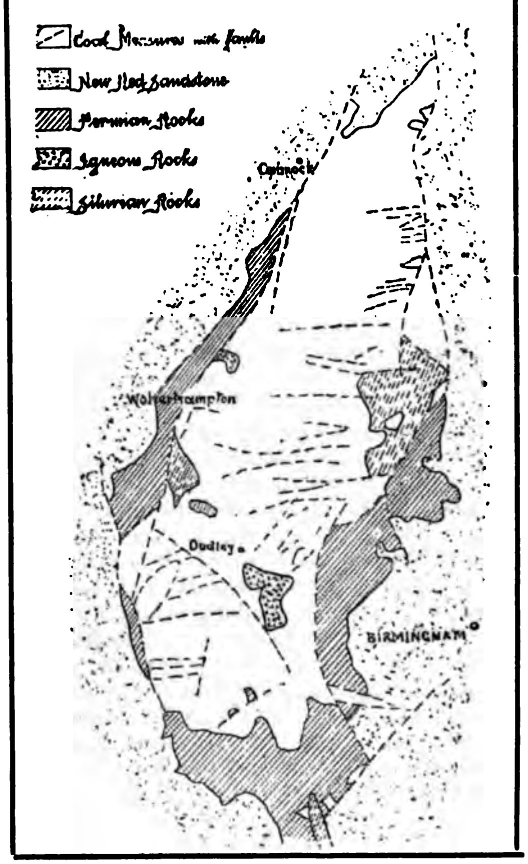
*Question* 5.—Describe briefly with sketch map the South Staffordshire Coalfield?

**Map of South Staffordshire Coalfield.**




*Answer.*—This coalfield has an area of about 140 square miles, having a length of about 20 miles in a northerly and southern direction. It has an extraordinary store of mineral wealth, and is known the world over because of its thick or Dudley coal seam. The average breadth east and west is only seven miles, and the total exposed area of coal measures is 93 square miles. The east and west boundaries terminate against two great faults. The coal-bearing strata rests on the eroded ages of the silurian series, differing from other coalfields in this respect, and forms a very interesting piece of the geological history of England, during the carboniferous period. On all sides of the coalfield we have the permian and new red sandstone rocks, these overlapping the true coal measures, and several deep mines have within recent years been put down through these formations to reach the coal seams. The succession and thickness of these formations met with are as follows:—Trias, 1,200 feet; permian, from 1,000 to 3,000 feet; upper coal measures, 1,300 feet; middle coal measures, 510 feet; upper silurian rocks. The dip of the strata is to the east. In the extreme south it dips towards south, but in the neighbourhood of Dudley and Rowley Ragg, which are two elevated masses of volcanic rock, the seams dip in all directions.

| Name of Seam. | Thickness of Seam. | Thickness of Cover in fathoms. |
|---|---|---|
| (1) Broock Coal.. | 4 feet thick .. .. | 130 |
| (2) Thick Coal .. | 24 feet to 30 feet .. | 150 |
| (3) Heathen Coal.. | 4 feet thick .. .. | 160 |
| (4) New Mine Coal | 8 feet thick .. .. | 179 |
| (5) Fire Clay Coal | 7 feet thick .. .. | 183 |
| (6) Bottom Coal.. | 12 feet thick .. .. | 190 |

The principal seam is the thick coal which splits up into 9 distinct seams, and is subjected very much to horse-backs and wash-outs. Thie field possesses some of the finest beds of ironstone in the world. The principal beds are the pins and pennyearth, grans ironstones, the gubbin, the new mine, poor robin and white ironstone, silver threads, and diamond ironstones. The most noted fault is the great Bently fault. The mode of working adopted is longwall. The old mode of working used to be what is called "square work." Many of the seams give off a considerable quantity of $CH^4$, and strong water feeders. It was in this district where a system known as draining was first adopted for the ventilation of the seams of coal. On account of such large quantities of water it is a great drawback, and within a few years the district will suffer a severe relapse, unless some better measures are adopted to remove these barriers to progress in the commercial line of mining.—

SAMUEL DAVIES.

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*Question* 6.—Mention some of the best explosives now in use in mines and give the composition of a few of them?

*Answer.*—The numerous explosives now in use in mines are sufficient to show to the mining student the remarkable progress made in this department of mining. Each of the many explosives has some characteristic advantage claimed for it which fits it for some special work. For instance, we may take two different explosives, one of which exerts a powerful action upon a small area, the other a weaker but more prolonged in its action upon a larger area. In this case the first will exert a shattering force, while the second exerts a rending action. So we here see plainly that the choice of an explosive depends

very much upon the nature of the work required to be done by it. In my opinion the following are the best and safest explosives known and used in mining operations at the present time.

(1) AMMONITE consists of two inexplosive substances: ammonium nitrate 90%, and nitro-napthaline 10%; it is one of the most powerful, safest and best of the high explosives known to modern science. (2) CARBONITE is composed of nitro-glycerine 90%, &c., carbon 10%. (3) BELLITE is composed of nitrate-ammonium &c., 85%, dinitro-benzine 15%. (4) ROBURITE is composed of 30% of chlorinated-dinitro-benzine, &c., and 70% of ammonia-nitrate. (5) SECURITE is composed of ammonium-nitrate &c., nitro-dinitro-benzol. (6) GELATINE is composed of 86% nitro-glycerine, 10% of soluble gun-cotton, &c., 4% of camphor.

The first five explosives are the most important compounds now in use, because they are nearly flameless. It is remarkable that the dilutants of flame used in these binary compounds render them difficult to explode, hence they require a very powerful detonator. So much is this the case that we neutralize flame in the shot, and intensify it in the detonator. Notwithstanding these remarks we fully believe that a thorough flameless explosive is now within easy reach. All the above-mentioned explosives are applicable to either fiery or non-fiery mines. Numerous experiments carried out the statement that they will not fire coal dust or gas if proper precautions are taken. There are also other "ites" in addition to the above. In giving preference to any kind of explosive the following important questions require our attention:—the price of it; the quantity required to perform the work; and the definite amount of work. And what are the relative dangers appertaining to the use of such explosive? This point is very important, and ought to be taken into consideration first of all.— SAMUEL DAVIES.

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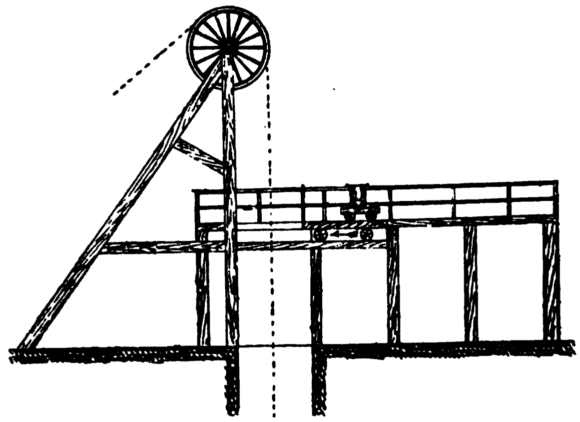
### FIRST-CLASS.

*Question* 7.—Describe with sketch the travelling jiddy used for landing the hoppit in sinking pits?

*Answer.*—What I presume to be a travelling jiddy is the wagon used for landing the kettle or hoppit when the latter reaches the surface. In small shafts where kettles comparatively small are used they were either drawn out by the hand when they reached the surface, or



swung out by a chain attached to the headgear. But where large shafts are being sunk kettles of a large size have to be used in order to remove the great mass of rock which is broken up, and as it is too toilsome and dangerous an occupation by the former methods, other means had to be resorted to. The accompanying sketch shows a bogie carrying a platform which is run on to rails laid across the shaft when the kettle has ascended above the banking scaffold. The kettle is then lowered on to the platform, and either another kettle is hung on to the safety hook, or the engineman lets out slack rope and allows the bogie and kettle to be drawn out and emptied into a wagon for the purpose, when it is run back and the kettle guided down the shaft in a brief space of time. The wagons into which the contents are emptied are run out when full and emptied into any hollows on the surface, or is utilised in forming an embankment for a railway. It is of such a construction that when full its centre of gravity is much higher than it should be in order to balance itself, so that when a pin is released the upper portion topples over and empties itself, when its centre of gravity is then in such a position as to balance itself, thus making it regain its former position.— JOHN McPHAIL.

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*Question* 8.—In wide work with packing, if the dip is steep, how would you ensure air being kept up to the face?

*Answer.*—In working a coal seam with a steep dip I would carry the in-take air into the dip working faces, and at the faces the air would be split right and left in equal quantities, according to the distance of workings and length of airway each split has to travel to the up-cast shaft. I would ensure the air being

kept up to the face by keeping each working-place well packed up, each pack being not more than three feet from the coal face; by keeping all back wood drawn out of the goaf, thus keeping the goaf well gobbed up; and by keeping each brattice cloth in good order in each gate road, or a good door in each gate road to protect the air current from rushing down or up the gate road on the nearest way to the up-cast shaft. By doing this I could keep the ventilation well up to the working faces.—HERBERT HALL.

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*Question* 9.—Describe with sketch the bricking soaffold you would use in a sinking pit 16 feet diameter. State how you would support it when in use, and how you would raise and lower it?

*Answer.*—The accompanying sketches show plan and sectional elevation of the bricking scaffold I would use in a sinking pit. It consists of a circular platform, 15 feet 8 inches in diameter, constructed of three-inch planks placed side by side, and held together by others nailed transversely across them. Some are constructed to fold in two halves, while others have two wings at opposite sides which can be folded up at pleasure to facilitate their removal when required. The scaffold is suspended by six chains attached to eyebolts passed through it and secured by nuts at the under side, and all six chains gathered together in one big link at the upper end, in the case of only one rope being used in altering the position of the scaffold, the winding rope may be continually attached to the scaffold while the walling is being built up, and the bricks, mortar, etc., let down on one side by another rope; or the scaffold may be rested entirely on the draw-bolts in its side which can be pushed out into the walling, while the winding rope is used for lowering the necessary material for walling purposes, this necessitating always the attachment of the rope in changing the position of the scaffold. Two ropes are generally used for suspending the scaffold in large shafts, three of the chains being attached to a big link on each rope, and the ropes passed over pulleys in the headgear to two crabs on the surface. By this method or arrangement the scaffold may be suspended continuously in the shaft during sinking operations, serving as a protection for the sinkers, and by means of using a loose cross-head attached to the rope the kettle may be guided to the surface after it comes through the hole in the scaffold, a square piece above the kettle fitting into a square recess in the crosshead. It is supported when in use by the two ropes running from the crabs at the surface to which these chains are attached on each side, and is also raised and lowered by the crabs before mentioned, being generally folded up when doing so.—JOHN MCPHAIL.

*(Sketch in No. 14, Vol. II.)*

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*Question* 10.—If you had two coals, the top one 9 inches thick, and the bottom 5 feet 6 inches with 8 inches parting between, and a soft friable roof, how would you proceed to work them and how would you proceed to open such seam?

*Answer.*—In working such seams with a soft friable or crumbling roof I would set them off by the stoop and room system. After the shaft pillar was formed I would drive main roads from the shaft and work the coal to the rise by taking out the five feet six inches, and keeping the eight inches of parting up as a roof until the boundary was reached, when the parting and nine inches of coal could be taken down and brought back as the pillars were taken out, so that no difficulty would be experienced in getting rid of the material got from the parting, as it could be used to pack the wastes during the latter operation.

JOHN MCPHAIL.

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## AWARDS

**FOR ANSWERS TO QUESTIONS IN THIS ISSUE.**

**ELEMENTARY.**—G. Tweddell, 13, Stanley Street, Lemington-on-Tyne.
*Commended.*—J. Hy. Senior, J. Stephenson, D. Turner, W. H. Luxton, J. Walsh, J. Graham, G. Hugill, Hy. Morcross, J. Eaves, F. Craggs, E. Colbeck, Jas. Jackson, J. T. Ward.

**ADVANCED.**—S. Davies, Park Road View, Worsbro' Bridge, near Barnsley.
*Commended.*—G. Daykin, T. E. Aitchison.

**FIRST-CLASS.**—J. McPhail, 6, Sourlie, Irvine, Ayrshire.
*Commended.*—Hy. Hall, J. Hardman, T. Lawrenson, J. Harrison.

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## Our GOLD MEDAL and other Competitions.

(SEE PARTICULARS ON COVER.)

FOR the edification of new readers we may state that it is not essential that the full series of questions be answered. Competitors may join at any time.

## CORRESPONDENCE.

MURTON COLLIERY, DURHAM.—*Errata.*

Sir,—Errors will continue to crop up in the best regulated establishments, and I notice various errors which I wish to correct and various items which need a little explanation in my article on the above.

(1) In No. 19, page 219, read 18 feet drums, instead of 18 inch drums, this is obviously a printer's error.

(2) In No. 20, page 233, read 14 seconds instead of 40 seconds. To be accurate in this detail I timed the changing both underground and surface on Oct. 10th, and found the tubs changed at the lower level in 10 seconds, and changed at the surface between 15 and 16 seconds.

(3) Under the head "Ventilation" I mentioned that the quantity of air circulating up the upcast shaft was 400,000 cubic feet per minute. I quoted this quantity from Mr. W. Baile's Mining Student's Handbook. Mr. Bailes was the son of a late manager of the colliery, therefore, what was true then is not now, and the present manager, Mr. C. W. Martin, informs me that the amount of air now circulating by the monthly measurements is nearly 500,000 cubic feet per minute.

(4) I spoke of the new smoke-stack being built above the upcast shaft increasing the ventilation by giving a larger motive, hence a larger heating surface, but I beg to state that this is not the object for which the chimney is being built, but to carry the sulphurous fumes from the furnace above the dwellings of the workmen and the colliery in general. The chimney is rapidly attaining completion and is to be 80 feet high and costing above £1,000. G. A. HAWES.

CONGRATULATIONS ON OUR NEW SCHEME.

Sir,—Permit me to congratulate you on the new departure you are about to take during the coming session with respect to competition questions. Your scheme will offer to the student, for the price of your journal and the cost of his paper and stamps, an educational course equal in value to any yet offered at the price of one shilling per lesson. Hoping that it will be the means of increasing the circulation of "Mining" and at the same time helping the persevering student to the top rungs in the ladder.

S. THORPE.

MINING PROBLEMS.—QUERIES.

Sir,—I would be pleased if you would insert the following questions, and thankful if any of your able readers will answer the same:—

(1) Explain how a steam engine is indicated.

(2) Describe the precautions necessary for driving an underground road to meet a point in old workings plotted from magnetic surveys twenty years ago.

(3) How do you check the accuracy of "sight lines" in driving a main road when the roof is liable to give way.

An early answer to the above would greatly oblige

IMPROVER.

Sir,—Will any of your readers kindly answer the following questions? (1) What is an M.E.? Is he a colliery manager, or what? (2) What is a C.E., and what are his duties? An answer will oblige,

EL DIABILO.

MINING PROBLEMS.—ANSWERS.

Sir,—In No. 23, Vol. II, of your paper, IMPROVER gives the following questions:—

(1) A colliery produces, per week, 6,500 tons of *large coal and* 1250 tons of small coal. The wages cost *on the total output is 3s. 4½d.* per ton. What is the cost per ton of the large coal when it is debited with the entire wage expenditure, and credited with the value of the small coal at 2s. 10½d. per ton?

*Ans.*—6500 + 1250 = 7750 tons output. 6500 tons at 3s. 4½d. per ton = 26156s. 3d. total cost, 1250 tons at 2s. 10½d. per ton = 3593s. 9d. Cost of 6500 tons when debited with the entire wage expenditure and credited with value of small coal =

26156s. 3d.
deduct 3593s. 9d.

22562s. 6d. = 3s. 5$\frac{1}{13}$d. per ton.

(3) Would the graduation of the tube be affected by altering the capacity of the bulb? Give the reason for your answer.

*Ans.*—Yes, the graduation of the tubes would be affected by altering the capacity of the bulbs in a maximum and minimum thermometer, just in the same way as an ordinary thermometer. For example, if the bulb be enlarged for every degree of heat, the liquid will move further along the tube (being more liquid in the bulb there will be greater expansion in the tube) than it had originally done. If the capacity of the bulb was enlarged without increasing the quantity of the liquid, part of the liquid that was in the tube will be in the bulb, and the graduations will be wrong.

MINER.

PROVING OF FAULTS.

Sir,—In answer to WESTHOUGHTON'S query on the above subject, I am dubious as to it being a fault. From the perpendicularity of the listing or ladder I should conclude that it was a thin clay dyke, consequently the seam will be lying in alignment beyond the dyke. I would advise WESTHOUGHTON to cut through the listing. If it prove to be a fault its throw and distance may be determined by examining the strata through the listing, and ascertaining whether such strata lies above or below the seam, and at what distance from the seam. This, I think, would be more economical, and equally reliable to driving a drift and then boring upwards and downwards to find the seam.

JOHN STALKER.

## ANSWERS TO CORRESPONDENTS.

RECEIVED:—Universal Index, Invention, Technical World; also J. Stephenson, Peter Riley, Jos. Wheatcroft, R. Roseley, Doubtful, Daykin, J. Harrison.

THOMAS WEBSTER.—The rules as stated in the Competition Questions must also be complied with in the Gold Medal and other Competitions. Any kind of writing paper will be suitable for the answer, foolcap paper however preferred. Sketches should be on unruled paper, and need not be on the same sheet as the answer, but should be attached to it.

A.B. (nr. Wakefield)—As stated in last issue essays may be sent any time before the close of the Competition, but we would suggest that one may be sent in the first half of the session and the other in the second half. A definite number of marks will be counted for each of the two essays, and the marks obtained by the competitor will be added to the marks obtained in the Competition Questions. Our address is "Mining" Office, Clarence Yard, Wigan. Literary communications to be sent to the Editor, and business communications to Messrs. STROWGER & SON.

M.B. (Darlington)—We may publish some of the essays in our paper when suitable. The Competitor's name will be published with the essay. The subjects you name would be suitable. See last issue.

*Printed and Published by* STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

# MINING

A JOURNAL DEVOTED TO THE INTERESTS OF MINI…

No 26. Vol. II. SATURDAY, NOVEMBER 17, 1894. FORTNIGHTLY. ONE PENNY.


## CONTENTS



## EASY LESSONS ON MINE SURVEYING

### For Beginners.

*Commenced in No. 2, Volume II.*

THE VERNIER, AND HOW TO READ IT.

A VERNIER may be said to be a contrivance by which readings can be obtained from a scale to a fraction of the divisions into which it is divided. The vernier consists of a small scale which slides along the scale from which the readings are required, and the divisions of the vernier are such that they are a definite fraction greater or smaller than the divisions on the scale or limb.

When the divisions of the vernier are larger than the limb divisions it is known as a *retrograde* vernier, and when they are less as a *direct* vernier. Fig. 77 shows a straight limb retrograde vernier. The scale is an ordinary inch one, and each inch is divided into 10 divisions, therefore each division measures $\frac{1}{10}$th or ·1 of an inch. Now, it will be seen that 10 divisions on the vernier equal 11 divisions on the limb, and as the limb divisions are $\frac{1}{10}$th of an inch, the 10 divisions of the vernier equal $\frac{11}{10}$ths of an inch. Therefore, each division on the vernier equals $\frac{11}{10}$ths $\div 10 = \frac{11}{100}$ths of an inch, or in other words, $\frac{1}{10}$th + $\frac{1}{100}$th of an inch; that is, each division of the vernier is $\frac{1}{100}$th or ·01 of an inch greater than a limb division. Now to read off the measurement the vernier is slided

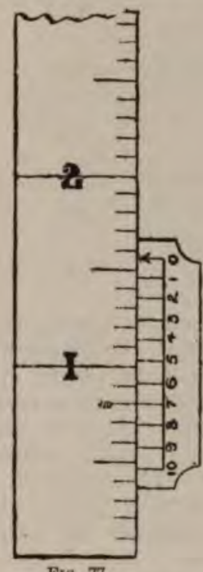


FIG. 77.

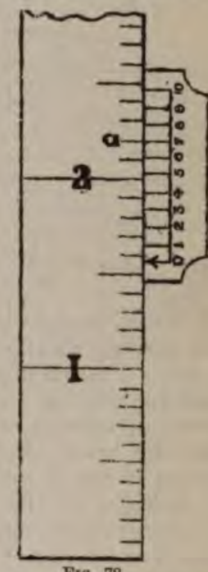


FIG. 78.

along until its zero mark exactly coincides with the point to be measured, the end of the limb or scale being the other end of the measurement. It is apparent from the position shown in the figure that the reading is between 1·5 and 1·6 inches, or 1·5 + a fraction of one-tenth of an inch, and the use of the vernier is to ascertain this fraction correctly. Look along the vernier divisions and see what division on it exactly coincides with a scale division, as of necessity one must do, and it will be perceived that it is marked 7. Then the reading is 1·5 + ·07 = 1·57. To show how this is arrived at take

the division on the scale which coincides with the 7, namely ·8. To obtain the measurement the seven divisions of the vernier will require to be added, and as each division is $\frac{11}{100}$ths, seven divisions = $\frac{77}{100}$ths or ·77. Then, ·8 + ·77 = 1·57 as before.

Fig. 79.

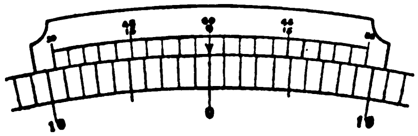


Fig. 80.

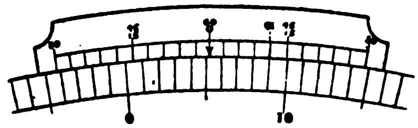


Fig. 81.

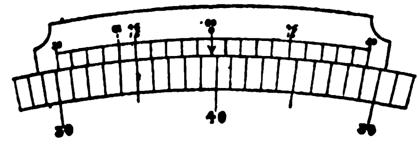


Fig. 82.

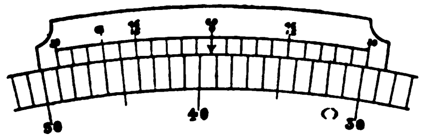
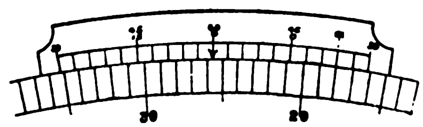


Fig. 83.



A direct straight-limb vernier, giving the same reading as the foregoing, is shown by fig. 78. The ten divisions of the vernier are equal to nine on the scale, therefore each vernier division is one-hundredth or ·01 *less* than the scale divisions, or each vernier division is ·09 of an inch. The numbers of the divisions on the vernier (fig. 78) are in the opposite direction to those on the retrograde vernier (fig. 77), but it will be seen that the reading is the same, the seventh division on the vernier being the one which coincides with a scale division as before. To reason the measurement out take the division on the scale which coincides with the vernier, namely, 2·2. From this there requires to be deducted, so as to obtain the measurement, the number of divisions on the vernier between this point and the zero, namely, seven. Each vernier division = ·09 inch, therefore seven divisions = ·09 × 7 = ·63 Then, 2·2 — ·63 = 1·57, as obtained *previously.*

We have so far confined ourselves to the straight-limb vernier, but what is of more consequence to our subject is the arc vernier, which is fitted to angular instruments. The reading of the vernier is the sticking point of all beginners in surveying, and as it is an essential part of racking or fast-needle surveys this difficulty should be mastered once for all. The arc vernier is employed to read fractions of a degree, and the limit of this fraction in ordinary mine surveying instruments is one-sixtieth of a degree, or one minute. The ordinary miner's racking dial is graduated to degrees, in which case the vernier limit is one-twentieth of a degree, or three minutes. Theodolites and some of the miner's dials are graduated to half-degrees, and the vernier limit of reading is one minute.

Fig. 79 shows part of the limb graduations and vernier of a dial graduated to degrees. Twenty divisions on the vernier equal nineteen on the limb, therefore each vernier division is one-twentieth degree or three minutes less than the limb graduations, and this is the limit of reading of the vernier. The reading is taken from the zero of the vernier in every case, and as readings are taken both to the right and left, a double vernier is necessary, or what is equally as well, two half-verniers one on each side of the zero. For example, if a reading is taken to the left the left half of the vernier is used to read up to thirty minutes, but if this is exceeded the right half of the vernier is brought into requisition, and the top figures are read. In the same manner the right half reads up to thirty minutes, and the left half reads from thirty to sixty when taking readings to the right. On the *proceeding* half of the vernier the lower figures are read, and on the *backward* half the top row of figures are read in either case.

To make this more explicit we cannot do better than take a few possible examples showing the vernier reading under or over thirty minutes, both to the right and left of the zero graduation of the limb. In fig. 80 the vernier is moved to the right of the limb zero. Now, what is wanted is the angular distance it has been moved, that is, the number of degrees between the zero of the limb and the zero of the vernier. If we, therefore, read off the graduations on the limb opposite the zero of the vernier, we obtain the reading in degrees. This we find to be between 5 and 6, or 5 degrees + an unknown number of minutes, and we now require to find the number of minutes by means of the vernier. Look along the vernier graduations

until one is found that exactly coincides with a limb graduation. This will be the one marked *a*. Now, it will be noticed that the coinciding graduation is on the right-hand vernier, and as the vernier has been moved from the zero of the limb to the right it is the *proceeding* vernier, therefore the lower set of figures of the vernier are read. Counting from the vernier zero, we find that the coinciding graduation is the fourth, and as each division indicates three minutes, the reading is twelve minutes. (It will be noticed that the next graduation gives fifteen minutes.) This twelve minutes must now be added to the five degrees previously read, giving as a final reading five degrees twelve minutes.

In fig. 81 it will be seen that the vernier has again been moved to the right, as this is the direction of the increase in the numbers of the limb graduations. The reading on the limb opposite the zero of the vernier is between 39 and 40, or 39 + a number of minutes which will be determined with the vernier. We again look along the graduations of the vernier until a coinciding line is found, when it will be noticed that it is the one marked *a*, and that it is on the left-hand vernier or what in this case is the *backward* vernier. The reading is therefore taken from the top row of figures which read from the edge towards the centre. The coinciding graduation is one nearer the edge than that marked 45, and as the numbers decrease in this direction and each division equals three minutes, the reading is $45 - 3 = 42$ minutes. This added to 39 degrees gives as a final reading 39 degrees 42 minutes.

Taking fig. 82 next into consideration, we perceive that the vernier has been moved to the left, and that the limb reading opposite the vernier zero is between 39 and 40, or 39 + a number of minutes which will be found with the vernier. Looking along the vernier graduations as before we perceive that the coinciding line is that marked *a*, and that it is on the left-hand or *proceeding* vernier. We then know that the reading of the vernier must be taken from the lower set of figures, and see that it is two graduations or six minutes past the fifteen minute divisions, therefore the reading is 21 minutes. The final reading is therefore 39 degrees 21 minutes.

In fig. 83 the vernier is again to the left. The limb reading opposite the vernier zero is between 25 and 26, or 25 + a number of minutes yet to be determined. The coinciding vernier graduation is *a*, and we see that it is on the right-hand or *backward* vernier. therefore the vernier reading must be taken from the top row of figures. The *a* graduation is two divisions or six minutes from the outer edge, which gives as the vernier reading $30 + 6 = 36$ minutes. This added to the limb reading gives as a final 25 degrees, 36 minutes. (*To be continued.*)

## COMPETITION QUESTIONS.

### No. 3 SET.

To the sender of the best set of Original Answers in each Stage will be awarded the following:—

**Elementary 2s. 6d., Advanced 3s. 6d., First-Class 4s. 6d**

A Competitor may only answer one Stage in each issue, though a different Stage may be taken in another issue. The best answer to each question will be published with the sender's name and address.

1.—All envelopes must be marked "COMPETITION."
2.—To be written on separate sheets of paper with name attached, and on one side of the paper only. Sketches to be in ink on *unruled* paper.
3.—Correct name and postal address must be sent.
4.—They must reach us by November 30th, 1894.
5.—The Editor's decision as to winners to be final.

#### ELEMENTARY.

*Question 1.*—What is meant by cleavage, face, end?

*Question 2.*—When boring with rigid rods how is the borehole kept vertical, and what arrangements are made for changing the rods? Give sketches.

#### ADVANCED.

*Question 3.*—Describe the various methods of transmitting power adopted in mining operations, and discuss the efficiency and adaptibility of each.

#### FIRST-CLASS.

*Question 4.*—Describe, with sketches, the MATHER & PLATT method of boring, and give details of how the rotary motion of the cutting tool is obtained, and how a shock is prevented in the steam piston employed for lifting the cutting tool sufficiently high to give the stroke.

*Question 5.*—How would you work three seams of coal lying 20 feet from each other, the first seam being 5 feet thick, the middle seam 5 feet 6 inches thick, and the bottom seam 4 feet 6 inches thick.

*NOTE.—Competitors will please remember that only one side of the paper should be written on; the name and address should be written after each question; sketches should be on unruled paper, and should be attached to the question to which they refer. If an answer occupies more than one sheet of paper the several sheets should be fastened together. Compliance to the above will save us considerable annoyance.*

# ENDLESS HAULAGE.

## ENDLESS ROPE SYSTEM.—(Contd.)

### Modes of Attachment to Rope.

The Hardy Patent Pick Co. manufacture two haulage clips as shewn by figs. 11 and 12. The clip shown in fig. 11 is of the pincer type, the two arms being kept together by means of a sliding collar. Fig. 12 represents a clip which is worked by a screw. The boys who attach and detach the tubs are each provided with a key which fits the top of the screw, and the plates can be tightened or loosened at pleasure. This is not a very good arrangement, its disadvantages being that keys are necessary, and that the clip cannot be worked quickly.

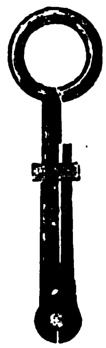


Fig. 11.

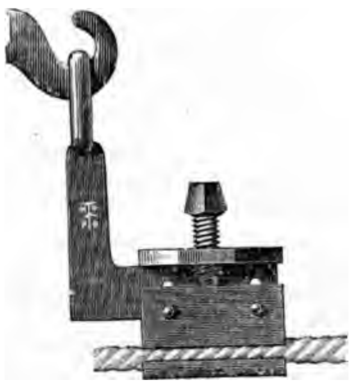


Fig. 12.

Fisher's clip (figs. 13 and 14) consists of a hook, to the lower end of which is a hinged piece, which can be doubled back over the rope and secured by a sliding collar. In order to prevent excessive wear on the rope the recess in which the rope fits is provided with two bushes of soft iron, so that the bushes wear away instead of the rope. They can be easily replaced when worn, being kept in position by means of rivets. This clip is easily and quickly attached and released, and the rope is held securely.

The Kinson clip (figs. 15, 16, and 17) is somewhat similar to the foregoing, but instead of the two pieces which form the clip being connected by a hinge the shorter piece is provided with a lug, which enters a hole in the hook and allows of a certain amount of motion. The lug is prevented from leaving the hole by the sliding collar, which cannot rise above the loose piece by reason of the fixed stud or bolt head. The loose piece is made in the form of a bent lever, and when the collar is on the top arm of the lever the clip is open, but on its being pressed towards the bottom end the clips are held firmly together. The advantages claimed for this clip are, that

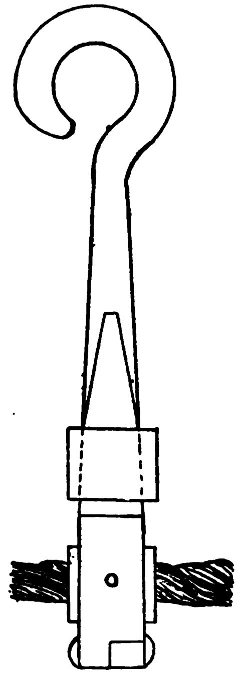


Fig. 13.

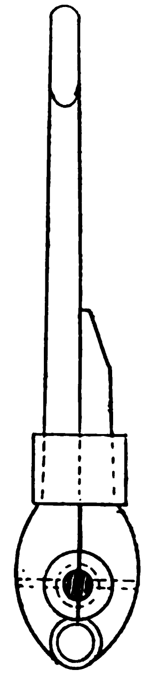


Fig. 14.

repairs can be easily and cheaply made, as any part can be quickly disconnected, and that the hardness of the jaws render bushing unnecessary. We doubt if the latter is really an advantage; if the jaws of the clip are so hard as to prevent wear, then the rope must be the sufferer.

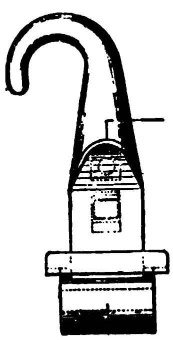


Fig. 15.

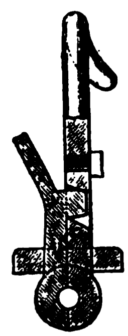


Fig. 16.

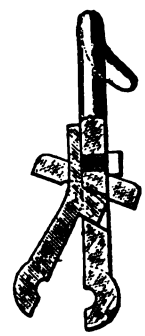


Fig. 17.

Mr. J. W. Smallman's clip (fig. 18) holds in either direction, does not damage the rope, is instantly attached or detached and never jars loose. The clip comprises two side-plates loosely joined together by a central nut and

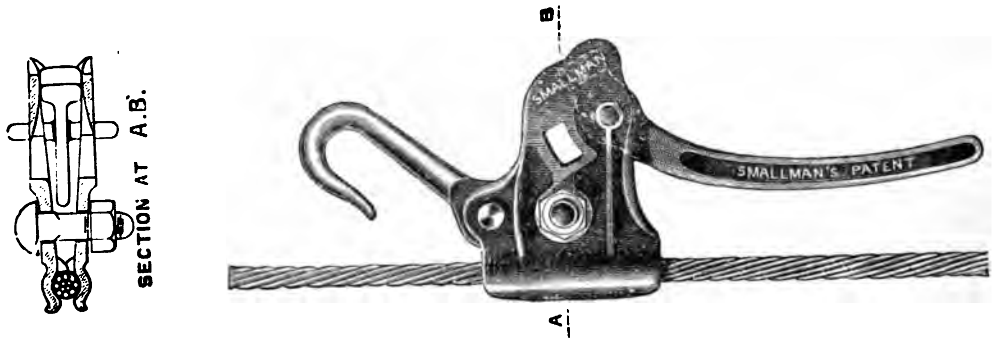
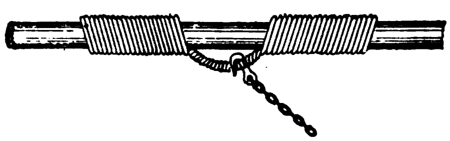



Fig. 18.

bolt. The upper ends of the side-plates are formed with inclines, between which the head of the lever works. The ring or hook coupling, by which the clip is connected to the tub or train of tubs, is usually pivoted to the side-plates by a cotter pin. When the handle of the lever is raised, the side-plates are free, and the clip may be easily dropped on or lifted off the rope. When the handle is depressed, the head of the lever, sliding along the inclines (*which should always be kept well greased*), forces the tops of the side-plates apart, and thus causes the grooved bottoms of the side-plates to approach one another and grip the rope; the nut serving as the fulcrum for one of the side-plates, the head of the bolt as the fulcrum for the other side-plate, and both side-plates as the fulcrum for the lever. It has lately been very much improved by the addition of a safety-catch on the lever, which drops automatically into place in attaching, but prevents the raising of the lever until it has been moved out into its inoperative position by hand. The clip can still be manipulated with one hand as before. It is made in three weights, namely, 11lbs., 14lbs., and 16lbs.

Fig. 19.



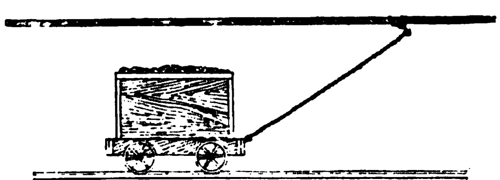


Fig. 20.

In the No. 2 or overhead system clips are not generally used, though a few good types have been designed. Attachment is usually made by means of short lengths of chain, which are either coiled several times round the rope and secured with the hook (fig. 20), or are attached by hooking the chain to a loop of hemp rope, which is secured to the haulage rope by string (fig. 19). The first method is the one almost exclusively used in Lancashire, and it possesses many advantages. It can be attached and detached in a very short time and will hold the load secure on all reasonable gradients, adapts itself freely to curves and can be attached to the rope at any point. To detach the chain the attendant presses midway on the chain sharply with his foot so as to take off the pull of the load thus loosening the hook, and the chain is uncoiled before the rope has travelled far enough to tighten it again. In both of the above methods, if the road is undulating it will be necessary to attach chains at both ends of the load, and as the tubs are attached singly, or at most in twos or threes the loop method of attachment is not suited for an undulating road, as so many loops would be required. The loop method is the more expeditious for attaching and detaching, and providing that the tubs are attached in small gangs and that the inclination is all in one direction it may be advantageously adopted.

## NOTICE.

As this number CONCLUDES our SECOND VOLUME, we have arranged to have a number of copies bound, which will be ready next week.

*(SEE LAST PAGE OF COVER).*

# WIRE ROPES.

### Working Loads for Round and Flat Wire Ropes.

For vertical winding at a quick speed, the load, including weight of rope between pulley and pit bottom when the cage is down, should be taken at one-tenth, or for moderate speed, one-eighth of breaking strain. For inclines, the working strain of round ropes will vary according to gradient, and friction.

### How to Uncoil Wire Ropes.

Place the coil on a reel or turn-table and uncoil from the outside end. The rope should never be uncoiled from a stationary position or it will kink.

### Storing of Wire Ropes.

They should be kept in a dry place and placed upon timber six or eight inches from the floor, covered with a tarpaulin sheet and occasionally oiled over as much damage at times result by corrosion through improper storage.

### Preservation of Wire Ropes.

When ropes are exposed to the destructive action of mineral or acidiferous waters, they should be made of galvanized wires, and of as large a gauge as possible. In all cases a protection is afforded by frequently lubricating them with a good grease free from creosote, ammonia, acids or other injurious admixture. It is of special importance that any broken wires should be cut away, or what is better, that they be bent backwards and forwards until they break off short at the place where they disappear into the rope, otherwise the broken wires, in consequence ef the pressure, are apt to damage the neighbouring ones in passing over the drum, and in this way whole strands in a partly worn rope are often destroyed.

### Round Winding Rope Pulleys.

The groove should be quite smooth and sufficiently wide so as not to pinch the rope. The pulleys should be regularly inspected, and if it is found that the rope has been working a false groove into the pulley, the groove should be turned to its former shape, which can be done by fixing a cross-beam to serve as a rest for the turning tools. The false groove seldom harms the rope that has made it, but quickly damages the new rope which takes the old one's place, and which, not being worn, is of a larger diameter than the old rope, and does not fit in the false groove, therefore it the more rapidly wears on the sharp edges formed by the false groove with the original groove.

### Flat Winding Rope Drums and Pulleys.

The drum arms or horns should be placed so far apart that the rope has not more than about one-fourth of an inch play between them. The inner edges of the horns should be well rounded off so as not to chafe the rope. The pulleys for flat ropes should have the grooves turned perfectly true and cylindrical neither concave nor convex as bell pulleys are. Lang's lay wire ropes are strongly recommended, because the friction surface is so comparatively small when constructed by the ordinary method that the strands are only worn on the crowns. The wires retain their full size and strength at each side of the worn or weakened parts, causing them to give way, although the greater portion of the wires have been subjected to no wear whatever. In the construction of Lang's lay ropes, we have a much larger wearing surface, which almost entirely removes the cause of the wires breaking on the crown of the strand, and as the working of the ropes around pulleys, drums, &c., bends the wires in an oblique direction, we secure by this system the greatest possible amount of wear from the wires before fracture, as they will not break before they are so much reduced in strength as to be too weak throughout for the work The wires in the strands of the ropes on Lang's lay principle have a very much longer bearing one against the other than in the old system, and we are thereby enabled to prevent the great injury which results from the wires in the adjoining strands cutting into each other.

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We wish to draw our readers' attention to the way in which the Competition Letters are forwarded to us. We have daily to pay extra postages for same, which if forwarded per book post, with the ends open, could be sent for *One Halfpenny*.

## ANSWERS TO QUESTIONS.

### In No. 23, Vol. II.

### ELEMENTARY.

*Question 1.*—Describe, with suitable sketches how the junctions and landings of the wagon-roads underground are made. Explain under what conditions each are used.

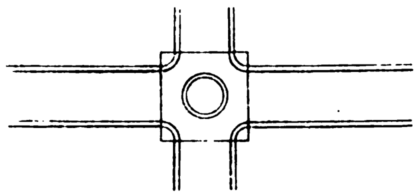

FIG. 1

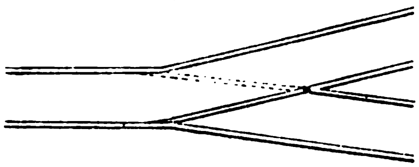

FIG. 2

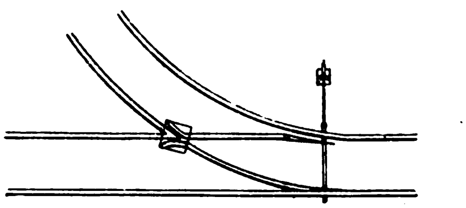

FIG. 3.

*Answer.*—There are various forms of junctions employed underground according to the importance of the position for which they are required.

For temporary roads in the workings where there is little space, plates are usually adopted. (Fig. 1.) The plate is of wrought or cast iron, about three feet six inches square, and is provided with raised angle pieces at the corners and sometimes a ring in the centre to facilitate the turning of the tub.

For more permanent roads switches are used. Fig. 2 shows a simple form of switch which consists of a movable rail, six feet long, pivoted at one end so that it can occupy the position as shown in the sketch or that shown by the dotted line. A more elaborate arrangement, and one generally adopted for important positions is shown by fig. 3. The junction is formed by a suitable casting and two wing pieces which are switched to the side required by means of the lever.—WM. JONES.

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*Question 2.*—What is the cause of acid water in mines, and how are pumps protected against its action?

*Answer.*—The chief cause of acid water in mines arises from the presence of the sulphates. As the water flows through the strata above the coal it comes in contact with iron pyrites, sulphate of magnesia, lime, etc. It takes up into solution the sulphur from these sulphates and thus forms sulphuric acid. The pumps through which this water passes soon corrode if some means are not taken to prevent it. Many plans have been tried such as steeping the pipes at a red heat in coal tar. Thus the pores of the metal are filled, and the skin of the metal covered with a film of graphite, but the valves and valve seats, and other important parts are better made of gunmetal, and the pumps lined with thin staves of oak or some other hard wood.—JOHN STEPHENSON.

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*Question 3.*—What are cannel, hard steam coal, and anthracite, and where are they chiefly found in the United Kingdom?

*Answer.*—Cannel coal is commonly considered a variety of bituminous coal, with the beds of which it is not unfrequently associated in parallel layers. It is of a dull black colour and has a conchoidal fracture. On examining the coal the spines and teeth of fishes are frequently found. It yields, on distillation, a high percentage of olefiant gas. Cannel coal is largely used for making gas, and it commands a high price, as a gas coal, in the market. It is frequently found as bands in ordinary bituminous seams, and when found pure the seam is usually small in thickness.

Cannel coal is chiefly found in the Lanarkshire coalfield, in Scotland, and in the Lancashire coalfield in England. Average composition of cannel coal:—Carbon, 80%; hydrogen, 6%; oxygen, 7%; sulphur, 1%; ash, 6%.

Hard steam coal is usually a dull black colour, and its fracture is sub-conchoidal. It is easily known by the whole flakes of felspar that are seen in its cleat. It does not bind when burning. Owing to its non-caking qualities the coke obtained from it is brittle and useless for commercial purposes. The finest qualities of steam coals are found in the Northumberland and South Wales coalfields. Average composition:—Carbon, 80%; hydrogen, 5%; oxygen, 11%; sulphur, 1%; ash, 3%.

Anthracite coal is extremely hard, dense, and strong; is non-flaming, and does not soil the fingers. It is less easily kindled than other coals, and although difficult to ignite, it evolves an intense heat when in a state of perfect combustion. It is used for the manufacture of zinc, in generating steam, and in

distilleries, breweries, lime and brick kilns. Anthracite is found chiefly in South Wales in the United Kingdom. Average composition:—Carbon, 92%; hydrogen, 3%; ash, 5%.—

GEORGE BROWN.

### ADVANCED.

*Question 4.*—Give an account of the Somersetshire coalfield, and of its relation to the carboniferous strata east and west of it. Give sketch map.

*Answer.*—The Somersetshire coalfield is principally related to the basin of the Severn on the west, and the Gloucester measures on the east. This coalfield is rather peculiar in form—similar to a triangle in shape, about 26 miles long and about 7 miles along the base. The coal measures here are very much tilted up from their original state of formation into an inclined position, and they are for a considerable area covered over unconformably by the new red sandstone and oolite of that district. The coal is exposed in patches, a large number being covered over by newer formations. They rest on the south-east and north-east upon the mountain limestone; on the east they are covered by the Bath oolites, so that their termination in this direction is rather uncertain. The measures of this field are divided into three series, viz.:—(1) The upper consists of the Radstock group, containing four seams of coal, the aggregate thickness being about 12 feet. (2) The middle series consists of the Farringdon group, containing four seams of coal, varying in thickness. (3) The lower series is composed of the Bedminster and Volister group, containing from 20 to 35 seams of an aggregate thickness of nearly 60 feet. The most remarkable feature here is the thinness of the coal seams, and as the seams approach the mountain limestone they are thrown nearly into the vertical position, so that a shaft may follow or be sunk parallel to the seam for a .distance, more or less, of 200 to 300 yards Many of the coal seams are so broken and crushed by lateral pressures, etc.. as to be of no commercial value.—SAMUEL DAVIES.

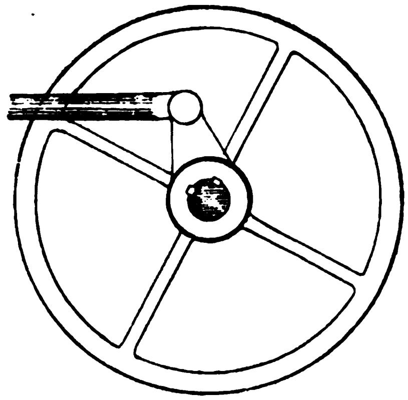
[*No suitable sketch received.*—ED.]

*Question 5.*—How should steel-wire drawing ropes be handled, when in use, to prevent accidents from sudden breakage?

*Answer.*—There are several points to be taken into consideration respecting how to deal with and handle drawing ropes so as to avoid accidents, such as loss of life and damage to property. They may be enumerated as follows, viz.:—(1) Wire drawing ropes should not be worked round drums or pulleys of insufficient diameter. (2) The drums, pulleys and sheaves should have a radius proportionate to the diameter of the rope. (3) There is danger in having excessive loads. No rope should have a maximum load greater than the safe working load which is laid down by the manufacturer. (4) The speed of drawing should be regularly maintained, and the weight should not exceed $\frac{1}{8}$th of the breaking strain. (5) The engine should be so started as to take the load gently, and avoid damage to the ropes from sudden jerking. (6) The course or path of the rope should be kept as straight as possible. (7) A careful, steady, experienced and qualified engineman should be appointed to take charge of every engine. (8) All working ropes should have a regular and thorough dressing laid on by passing the rope between roller brushes, these being well fed with wire-rope grease. (9) The ropes should be properly inspected once every day, cleansed of all dust and dirt, and then greased thoroughly. (10) When used in a furnace shaft they should not be allowed to remain in the same when the pit is not drawing; the cages should be raised and lowered alternately now and again. (11) Spring bearings are factors of safety when fixed to the winding pulleys, and also when fixed at the bottom of the shaft so as to allow of the easy and gradual settlement of the cage when the shaft bottom is reached. (12) The capping of ropes should be done without rivets or pins, by means of hooks, bands, or sliding clams which are absolutely safe, and avoids the great danger of injury to the rope internally. (13) Lastly, the ropes should be changed end for end after they have been in use from six to nine months. The steel or wire drawing ropes should by all means receive every attention, care, and proper management.—

SAMUEL DAVIES.

*Question 6.*—Describe the different methods employed in gearing rope drums to winding engines, giving sketch of an example, with dimensions.



*Answer.*—In different shires or coalfields they have different ways and means of connecting and gearing rope drums to the winding engines. In some parts nearly all the drums are "keyed" or secured by keys on to the main shaft of the winding engine, the only exceptions to this being very small collieries, or where the winding engines are used for sinking operations. In these latter cases the load is only intended to run at a low speed in the shaft. The shaft of the drum in this case carries a large spur wheel with teeth of about $2\frac{1}{2}$ inches pitch, the teeth being about 5 inches in length, and nearly $2\frac{1}{2}$ inches in depth. The drums are usually mounted on a $4\frac{1}{2}$ inch shaft. The spur wheel of the drum is geared to the pinion wheel of the engine. In other mining districts the drums are fixed loose on the main shaft. This system or mode of connecting the drum gives great satisfaction, because the load can be better managed by the engineman. With hauling engines the drums are attached to the engines by means of the various clutch arrangements which are commonly used. SAMUEL DAVIES.

### FIRST-CLASS.

*Question 7.*—If the current in an underground road, six feet square, is maintained by a pressure represented by one inch of water-gauge, what pressure per square foot will be required to pass the same quantity of air along a road five feet square, both roads being of the same length?

*Answer.*—Let $a$ = airway 6 feet square, in which the current is maintained by one inch of water gauge. Let $b$ = airway 5 feet square. $\therefore p = \frac{K S V^2}{a}$ As $K$ is common to both, omit its value from both calculations. The relative velocities will be in proportion to the areas of the roads which, in this case, is as 25 to 36, the value of $p$ in the two roadways will then be in proportion:—

| (*a*) AIRWAY. | | (*b*) AIRWAY. |
|---|---|---|
| $p = \frac{S V^2}{a}$ | : | $p = \frac{S V^2}{a}$ |
| $p = \frac{24 \times 36^2}{36}$ | : | $p = \frac{20 \times 25^2}{25}$ |
| $p = 864$ | : | $p = 500$ |

Hence the pressure is in the ratio of 864 to 500 or 216 to 125, $\therefore$ the pressure in the 5-feet airway is equal to $\frac{216}{125}$ or 1·728 times larger. $\therefore$ the water gauge $1 \times 1{\cdot}728 = 1{\cdot}728$ inches water gauge, which is equal to a pressure of 8·8856 pounds per square foot. Hence, to produce the same quantity of air in $b$ as in $a$ we require a pressure of nearly *nine pounds per square foot,* thus shewing the disadvantage of a reduction in the area of an airway.— MYLES BROWN.

*Question 8.*—A coalfield having an area of 2,000 acres contains a vein of coal seven feet thick, free from faults, but at one part of the field the coal is 120 yards deep, and at the deepest part 480 yards. Assuming that the surface is level, which is the best place to open out and mine this coal by shafts? What method of mining is most suitable, and what sized pillars should be left for protection of shafts? Give sketches if necessary.

*Answer.*—There are many important items to consider before determining the position of the shafts, especially in connection with the opening out of a new coalfield. It is desirable to have the winding shaft near to a railway or navigable river for the purpose of disposing of the coal; also it is an advantage in a seam with a very slight inclination to have the winding shaft near the centre of the coalfield. But surface and royalty have to be consulted sometimes, and their decison may be totally different to the place most suitable as regards the underground conditions. Yet as to the position of the shafts in the coalfield given, taking into consideration the underground and surface conditions, I think the shafts should be sunk at the lowest point, namely, where the coal is at a depth of 480 yards. This would greatly facilitate the working of the mine as regards the transmission of coal, water, etc., which, under these circumstances, would

gravitate towards the shafts, this being an important factor as regards the economical working of a mine. The pumping, ventilating and drawing or winding shafts are generally situated near together to facilitate the management and arrangement of the surface works. Yet, the exact position of the shafts could only be determined by having all the important items supplied which are connected with the given area of coal, namely:—(1) The position of railways and markets. (2) The quantity of water to be dealt with. (3) The opinions and decisions of the royalty and surface owners. In some cases the drawing shaft is sunk to be near the surface railway, the pumping shaft at the lowest point, and the ventilating shaft at the highest point so as to procure the advantage of ascensional ventilation. If in the case given a large quantity of water is likely to be met with, I would recommend the winding shaft not to exactly be at the lowest point, so as to allow sufficient standage in case of accident to the pumps, thus not interfering with the winding of coal. Also, by taking note of the difference of the level of the seam at the two ends of the coalfield, it would appear that the inclination of the seam will only be about four on five inches per yard.

The method of haulage would be the endless rope, but the coals would all gravitate to the main roads if the shaft was at the lowest point.

The method of working the coal cannot be stated exactly unless we have a knowledge of the nature of the roof and floor or thill, and the various circumstances which are peculiar to the given seam and royalty. For instance, a knowledge of the surface and surface structures is essential, so that if it were required that the surface should not be damaged, we would have to adopt a method to suit the case. The conditions given are:—The seam of coal is seven feet thick and the royalty free from faults, the latter being an important and satisfactory item in any method of working. The seam being seven feet thick and free from band or dirt partings does not provide a very satisfactory outlook for adopting the longwall method, owing to the height of the seam and the absence of any refuse with which to build pack walls or to pack the goave. Yet, at the present time we find many modifications of all the methods in vogue.

Supposing the roof to be of a hard nature and lying in large beds or frames, I would adopt the bord and pillar method, following up with the broken, at the same time being careful to leave the pillars in the neighbourhood of main roads of sufficient strength to support the superincumbent strata. In the broken I would remove the pillars by driving twelve yard lifts up at each time, using chocks next to the goaf side (fig. 1.) Yet, the method of working would

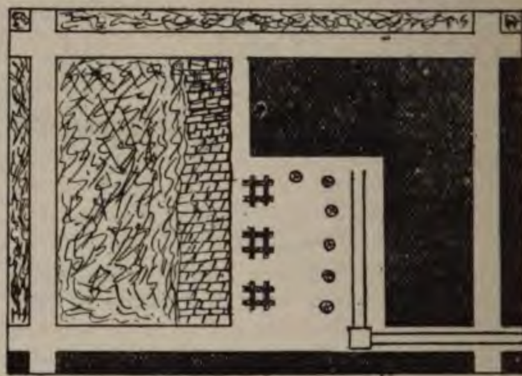


FIG. 1.

be influenced by the conditions presented by the seam after it had been commenced to be removed or worked. As in many seams more than one method may be worked to suit the conditions of the various districts. The different methods may be modified to suit the various conditions of any seam.

The size of pillars left for protection of the shafts depends on the following conditions:—(1) The presence of surface works or structures. (2) The nature of the roof or thill. (3) The depth of the mine. (4) Inclination of the strata and strength of the coal. (5) The presence of faults. (In the case given the seam is free from faults.) The size of shaft pillars depends on the foregoing conditions. Thus when the strata is highly inclined it requires a much larger pillar than when the strata lies horizontally. Also, any seam which is inclined requires a larger shaft pillar on the rise side of the shaft than on the dip side. Rocks generally break at right angles, or as sometimes stated, at an angle varying between 70 and 90 degrees to the line of stratification. Hence the line of subsidence is not vertically from the place of excavation, but vertically from the plane of the beds. An illustration of this is shown by the annexed figure (fig. 2).

Hence the size of pillars can only be determined by a knowledge of the various conditions. Many rules are given to calculate the size; one of them is as follows:—Shaft pillars not in any case to be less than 40 yards square, and the deeper the mine the larger the pillar, in the following proportion:—Suppose

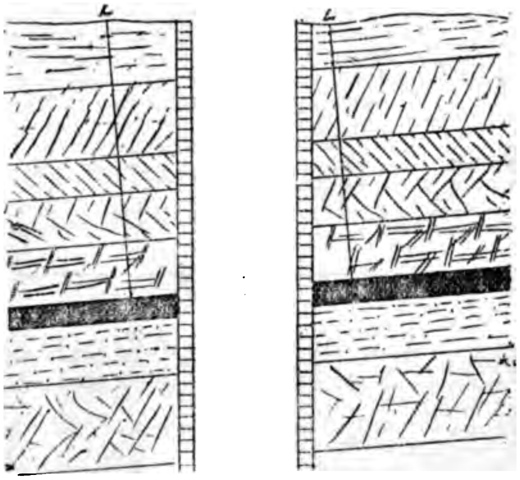


FIG. 2.

the minimum be 40 yards for a depth of 60 fathoms, then 10 yards must be added for every additional 20 fathoms, so that at a depth of 480 yards the shaft pillar would equal 150 yards square.

The opening out of a coalfield, as the one given, demands the service of much tact, thought, and careful, practical observation, so as to make the large undertaking a complete success to all concerned.—MYLES BROWN.

## AWARDS

FOR ANSWERS TO ABOVE QUESTIONS.

ELEMENTARY.—Wm. Jones, Trindon Grange Colliery, Trindon Grange, R.S.O., Co. Durham.

*Commended.*—J. Stephenson, G. W. Dobison, J. Jackson, W. H. Gray, G. Tweedell, G. Brown, Wm. Glass, H. Hall, J. Kay.

ADVANCED.—S. Davies, Park Road View, Worsbro' Bridge, near Barnsley.

*Commended.*—O. Hughes, G. Daykin, W. P. Laws, J. Harmer.

FIRST-CLASS.—M. Brown, Butterknowle, Darlington.

*Commended.*—J. McPhail, J. W. Evans, T. E. Aitchison, M. Chapman, A. Bedford, D. Spence, W. Littler, J. Harrison, R. Unsworth.

## Our GOLD MEDAL and other Competitions.

(SEE PARTICULARS ON COVER.)

FOR the edification of new readers we may state that it is not essential that the full series of questions be answered. Competitors may join at any time.

## CORRESPONDENCE.

We will publish a reasonable amount of correspondence per issue, but subject to the following conditions:—

To be written on one side of the paper only.

Envelopes to be marked "Correspondence."

Name and address of sender must accompany such correspondence as a sign of good faith, but the writer may assume a *Nom-de-plume* to be published if he so desires.

Correspondence must not be enclosed with Competition Answers.

The Editor will not hold himself responsible for any correspondence, nor will the publishing of it affirm that we hold the same views as the writer.

MINING PROBLEMS.—QUERIES.

Sir,—I would be pleased if your able correspondent, Mr. Myles Brown, or any of your competent readers would kindly answer the following questions at their earliest convenience:—

1. There is a feeder of 300 gallons of water per minute at the bottom of a pit 250 yards deep. What arrangement of pumps would you adopt and why? Give size of pump and other particulars.

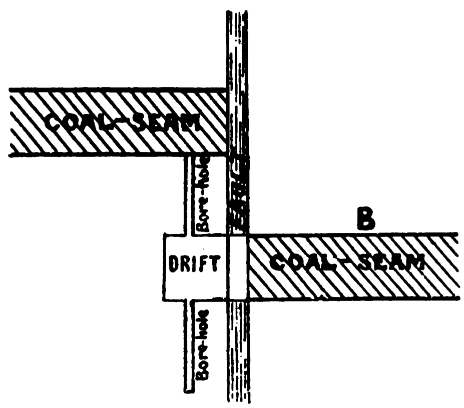
2. An upcast and a downcast shaft are each 16 feet diameter, the former 190 yards and the latter 200 yards deep. The airways in the mine are four in number, the frictional resistance in each being equal to that in an airway 6 feet by 4 feet, and 1,000 yards long. What pressure should the water gauge show in the upcast when 30,000 cubic feet of air is passing per minute?

3. What size of chain or steel rope would you require whilst sinking to carry a 14 inch set of pipes 80 yards in depth?

An early answer would greatly oblige

"PERSEVERANCE."

THE PROVING OF FAULTS.—ANSWER.




Sir,—In answer to "Westhoughton," I understand that the seam of coal has been interrupted by a fault, and there are no indications left whatever as to where

the dislocated seam lies whether upwards or downwards. Now the method which I think would be the best and safest to search for the lost seam is as follows:—Drive a drift straight through the fault into the regular strata beyond, say 8 or 10 yards, then examine the strata at the face of the drift and compare it with the shaft section to ascertain whether such strata lies above or below the seam he is now working. If he cannot make a comparison with this, then proceed to put bore-holes, one upwards and the other downwards, but take care to finish one before commencing the other. By boring to what he thinks to be a reasonable distance in the roof and floor of the drift he will find the seam of coal he wants. To explain it more clearly the sketch shows the coal seams, drift and bore-holes. B being the known side of fault.

DAYKIN.

### MINING OILS AND GREASE QUERY.

Sir,—Will you kindly in your next issue please give me a reply to the following questions through your valuable little paper, "Mining":—What oils and grease are used in a large steam coal colliery? Please give the names of the different sorts, and for what engine, cylinder or valve they are used. In the pit that I am working in there is the winding engine, pumping engine, and fan engine on top, and underground they have blast engines for hauling the full and empty trams. What grease is used for greasing trams or tubs.

J. H. JONES.

## ANSWERS TO CORRESPONDENTS.

RECEIVED.—Invention, Universal Index, Electricity, Technical World.

DOUBTFUL.—Our correspondent questions the correctness of the description of drawing chocks as given in Mr. J. CARTER'S Answers to Examination Questions. We think our readers may rely upon the answers given by Mr. Carter, especially the practical ones, as this gentleman is no theorist. He has had over a quarter of a century's practical experience in coal mines, and is at present managing a colliery in this district. We are always thankful, however, to readers for attracting our attention to what may be deemed a mistake, as it is our endeavour to make our journal as trustworthy as possible.

F. KING.—The illustration you send is unsuitable for reproduction in our journal. Make a pen-and-ink sketch, and we will try to accommodate you.

ANXIOUS TO KNOW.—Write to Director of Technical Instruction, County Offices, Preston, for particulars of the Lancashire County Council Scholarships.

ENGINE (Student, Warwickshire Mining School).—Many thanks for the syllabus and your suggestions. We are fully aware of the important part the subject of steam and the steam engine plays in the education of a mining student, and we hope to publish a series of articles in our next volume, which shall be fully illustrated as you suggest.

J. J. (Glam.)—Glad you like our paper, and are sorry you have not seen it sooner, you cannot under the circumstances do better than obtain the whole of the volume, of which this number is the last. You will find in it a quantity of valuable information for the Colliery Managers' Certificates. For the present we advise you to get either H. W. Hughes' book of Practical Coal Mining, price 18s., or C. Pameley's Colliery Manager's Handbook, price 25s. We will in all probability be able to assist you further in course of a few issues.

### USEFUL NOTES AND FORMULÆ.

*Water—*

Boiling point, 212° Fahr., 100° Cent., 80° Reaumar.
Freezing „ 32° „ 0° „ 0° „
One cu. ft. = 1000 oz. = 62·5 lbs.
One cu. ft. = 6·25 gallons.
One gallon of water = 10 lbs.

*The Circle—*

The diameter of a circle × 3·1416 = circumference.
The diameter of a circle × ·8862 = the side of an equal square.
The diameter of a circle squared × ·7854 = area of circle.
The radius of a circle squared × 3·1416 = area of circle.

*The Triangle—*

To form a square corner practically, form a triangle on the ground with the sides in the proportion of 3, 4 and 5.
The Base × ½ the perpendicular = area of triangle.
From ½ the sum of the three sides subtract each side separately; multiply the ½ sum and the *three* remainders together, and the square root of the product = the area.

### HER MAJESTY'S INSPECTORS OF MINES' OPINION OF "MINING."

Rainhill, Nov. 2nd, 1894.

Dear Sirs,
I have looked through your paper, "Mining," which you were kind enough to send me. I think it will be very useful to everyone seeking mining education, and I hope you may be able to make it a success.

Yours faithfully,
Messrs. Strowger & Son. HENRY HALL.

DEAR SIRS,
I have read with interest your journal which you were good enough to forward me, and it appears to be a remarkably cheap and good publication, and I hope will accomplish the object you have in view.

Yours faithfully,
Wath, 2nd Nov. '94. FRANK N. WARDELL.

Another of H.M.I.M. says "Mining" is the best paper for practical men published.—EDITOR.

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